THE FOUNDRY

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A St. Paul Casting.

The Northwestern States, as far as the foundry business is concerned, are situated at some disadvantage when compared with more southern and eastern territory. That natural obstacles does not hinder them from turning out first-class work is shown by the illustrations appearing herewith of a "Racer Casting," belonging to the 12-inch mortar carriages with which the United States Government has lately supplied itself. Thirty-five of these castings were made by the American Hoist & Derrick Company, of St. Paul, Minn., to whom we are indebted for the photographs here reproduced.

FIG. 1.

The specifications for these castings require that "they shall be made from gun iron, by which is meant charcoal iron melted in an air furnace, or by such other process as will give an elongation of not less than 0.25 of 1% under stress before rupture. The elongation is tested from a cylinder, 20 ins. long by 9 ins. diameter, with a 2-in. axial core, taken from each ladle of cupola iron, so as to fairly represent the iron in the casting. From these cylinders specimens are prepared with stems 10 ins. long, 1.129-in. diameter."

The specifications also require the castings to have coupons attached which shall show a tensile strength of not less than 28,000 lbs., and not more than 39,000 lbs. The required elongation is usually reached under a strain of about 20,000 lbs.

These castings are fourteen feet in diameter, have a depth of two feet and weigh fifteen tons each. Fig 1 shows the mold with nearly all the cores in place. Fig. 2 is a view

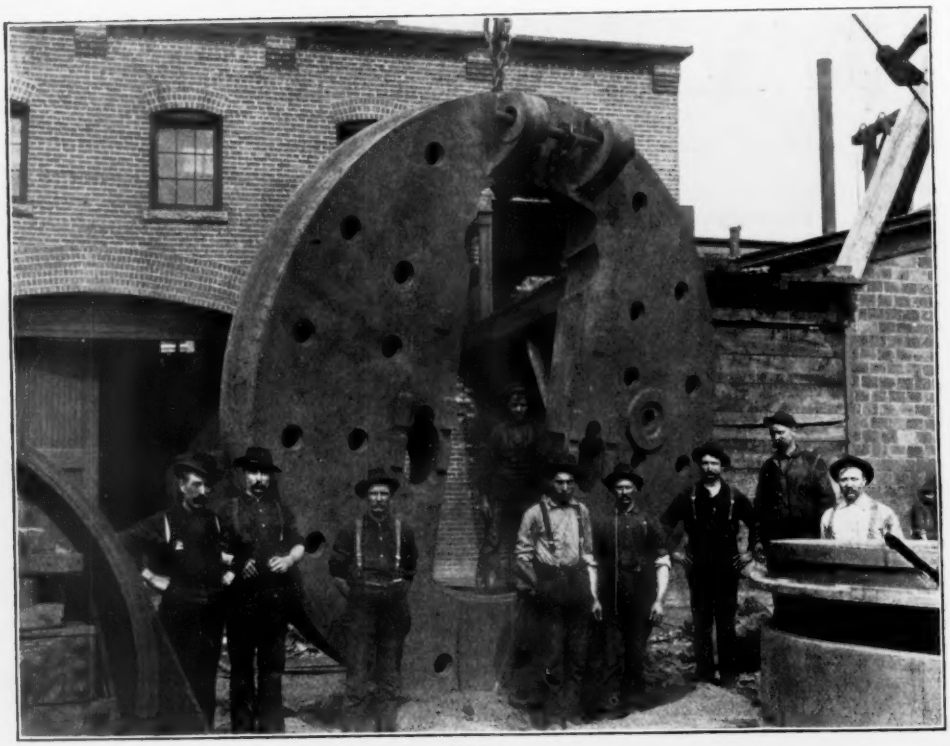


FIG. 2.

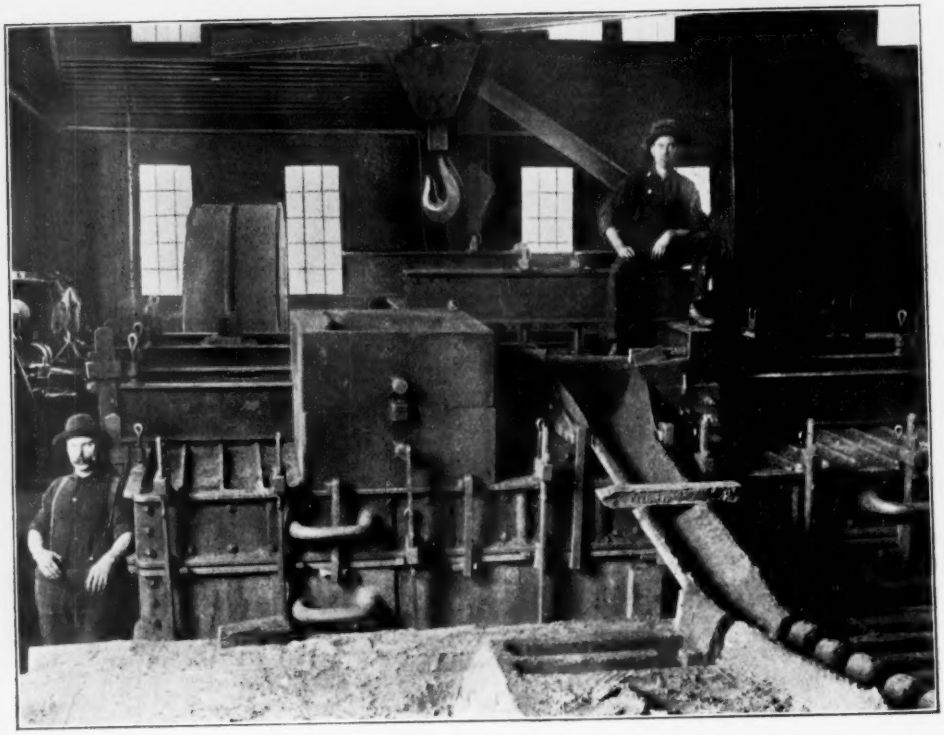
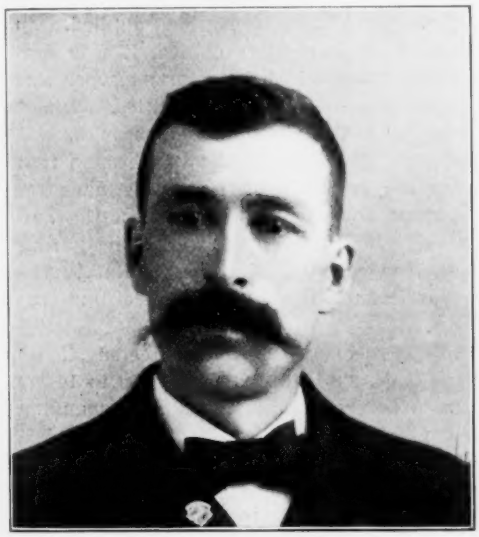


FIG. 3.

of the casting, the absence of imperfections of all kinds being notable.

Fig. 3 shows the mold ready for pouring and gives the reader a casual glance of the thoroughness with which it is secured. The adjustable clamps, of which a great number are seen, is a decided novelty in such a heavy class of work, but it cannot be denied that they tend to expedite the work of securing. Really it is surprising that a larger number of adjustable clamps are not used in general jobbing shops.

That the American Hoist & Derrick Co. believe in placing credit where credit is due is evidenced in their letter accompanying



P. J. O'CONNELL,
FOREMAN FOUNDRY DEPARTMENT AMERICAN HOIST AND DERRICK CO., ST. PAUL, MINN.

these photographs, when they say that, "Out of these thirty-five castings but two were lost, and these at the very beginning. Mr. P. J. O'Connell had charge of this foundry work and we deem it especially to his credit that so many large castings were made as near perfection as possible with such a small percentage of loss." It sounds good to have an employer praise the workmen of his foundry. It is so exceptional that we have taken the liberty of quoting these remarks without permission.

The New Hampshire Way.

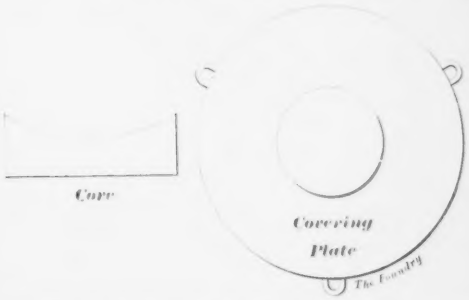
BY THOMAS SHEEHY.

The following is the method of making split pulleys in this part of the country.

We have the patterns made in two parts, one consisting of the arms and the other of the ring. For a 36-in. pulley we generally make the latter about 9-in. deep.

In molding we have a follow-board for the arms of the pulley, which by the aid of blocking can be placed to suit any width of face. These follow-boards not only save time in making the parting after the drag is rolled over but keep the arms in just the position they are wanted.

The ear prints for split pulleys should be pinned to the follow-board to prevent shifting. After the drag is rolled over and the parting made, the ear prints for the cope half of the pattern are placed in position, a lifting plate being used to carry the core above the arms. Before drawing the ring



pattern the runner is built to avoid getting any sand into the mold in doing this after the pattern is drawn. When the splitting cores are set and the lifting plate returned, a few weights are distributed on this part of the mold and it is then ready to be poured.

In molding pulleys I only use a cope when the pulley to be made is the full depth of the pattern.

The following comprises the speediest methods I know of for turning out various sizes of pulleys:

When pulleys are ordered with a hub shorter than the depth of face I cast them with the rim open.

When they are ordered with a hub longer than the depth of face and the casting is to be less than the depth of pulley pattern, I upset the drag on the follow-board side.

For instance, to get a casting with 6-inch face from a 9-inch pattern I upset the drag 3 inches and after the mold is all rammed up I take off upsets and strike off the outside of pattern flush with the joint of drag.

After pattern is drawn, mold finished and

inside core is lowered in place 1 cover the rim with a core as shown and weigh down the mold with a circular plate 2 inches thick as per sketch. This weight is made one and one-half inches wider than the diameter of pulley and it has three staples cast into it so as to be easier handled. The cover core fits against the inside of mold, which is leveled off even with the top of pattern.

These pulleys can be made any depth required and on an average a molder will turn out six a day.

The Manufacture of Car Wheels.*

Like other branches of mechanical industry, the manufacture of chilled iron car wheels has been steadily improving. Fifteen years ago it was customary to purchase and supply wheels to railroads on a mileage guarantee, the only restrictions as to quality being the depth of chill and the size, shape, and weight of the wheel.

Certain mixtures were used by the founder which were known by experience to produce a given chill, and this and the color of the fracture, with perhaps the mileage records, were his guides in continuing his work. Chemical analysis of the pig iron and the finished output were considered unnecessary, if at all contemplated, and the irons, both coke and charcoal, were bought by fracture and chill. Some founders used a certain percentage of steel scrap, but this never became, as far as the writer knows, common practice.

Today the progressive wheel-maker buys his irons on specifications, and checks them by chemical analysis, and every heat is tested physically and chemically. Records are kept of the strength and resilience of the various irons on the market, and of the manner in which his wheels fail, and as many as possible of these are examined in order to avoid duplicating unsatisfactory products.

The actual shape of the wheel has undergone little change from the original Washburn section, except in the matter of size and weight, but we have every reason to believe that the older wheels cannot be compared with modern wheels in strength or endurance. A seeming inconsistency may be occasioned by a long life of old wheels, but it must be remembered that no such weight was then carried as is now the practice, where every effort is made in the interest of economical train movement.

About the time when the drop test was first introduced, the writer was assistant superintendent of a railroad shop which contained a foundry making 100 wheels per day. The introduction of this test, and the failure of a number of wheels in service about that time, caused him to make efforts to secure a stronger casting. Each day, test bars were made along with the wheels, and these were subjected to transverse test, and a graphical record kept of the same, as shown by Figs. 1 and 2. The bars for this purpose were 2 inches square by 24 inches long, and were placed on supports 21 1-3 inches apart, and a centre load applied. As one-half the bars were chilled, it was considered that a 2-inch bar was a proper size to illustrate the chilling qualities, without becoming white through and through, and the span was fixed at 21 1-3 inches, so that when the proper deductions were made for the span and modulus of section, the corresponding direct stress was exactly four times the centre load, thus faciliating the preparation of the form for recording the tests.

The bars of wheel iron so tested should stand a centre load of from 12,000 to 14,000 pounds before breaking, this corresponding to a maximum fibre strain of 48,000 to 56,000 pounds per square inch. The deflection at the moment of breaking is also of great importance, and there are wide differences between various irons in this respect. While the strength of the metal indicates a power to stand pressure, we need the resilience to withstand shocks. A ready means of comparing the relative resilience of different irons is derived from the curves shown in Figs. 1 and 2. As the ordinates represent loads and the abscissae deflections, the area bounded by the axis of abscissas, the ordinate passing through the final point of the curve (i. e. the ordinate corresponding to the final deflection), and the curve itself will represent the work done or absorbed by the test bar up to the breaking point; and for quick comparisons the small rectangles into which the sheet is divided may be counted within the boundaries above mentioned. Good wheel iron will give curves with an included area of from 150 to 200 of the small rectangles, and a total deflection of 0.2 inch at centre. Of course these comparisons can

* From a paper read at the Washington meeting of the American Society of Mechanical Engineers, by G. R. Henderson, Assistant Superintendent M. P. & M., C. & N. W. Ry., Chicago.

only be made with bars of the same size and under the same conditions.

This same treatment has been accorded to unmixed pig iron of the various grades suitable for wheel founding, the pig being melted separately in a small experimental cupola, and from these records the wheel founder makes his selections. The curves present to the eye a meaning easier to grasp than mere figures, and when bound together in a book, comparisons can be quickly and accurately made. The amount of chill and shrinkage are also noted, together with the color of fracture and the chemical analysis of the iron.

amount of manganese is necessary in order that a wheel shall successfully stand the thermal test; it also seems to increase its strength under the drop test.

We have now seen that the wheel founder of the present day has the results of chemical analysis and physical tests of the unmixed iron and also of the mixture, as well as the results of the drop and thermal tests, to guide him in his work. The tests of today's heat are carefully studied by him in order that any defects may be corrected tomorrow. For this reason it is important that the analysis and deflection test should be placed in his hands early. The drop and

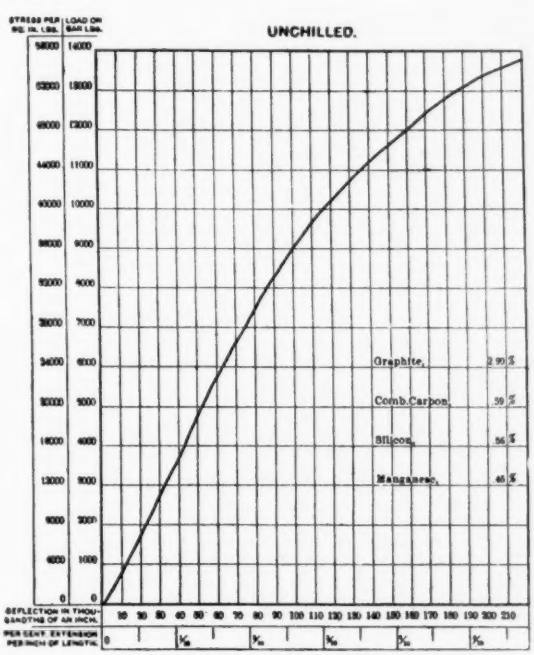


FIG. 1.

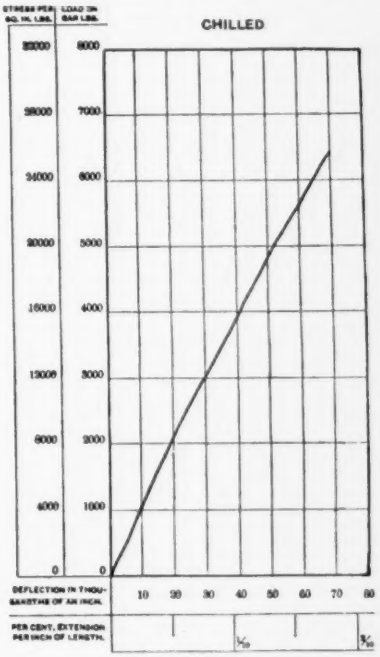


FIG. 2.

DEFLECTION AND STRESS DIAGRAMS OF CAR WHEEL IRON. SHRINKAGE PER FOOT, ⅛ INCH; DEPTH OF CHILL, ⅞ INCH; FRACTURE, GRAY.

As the composition of different shipments of iron from the same furnace will vary greatly, it naturally follows that the strength and chilling properties are not always the same.

It happened not long ago that a certain iron, which had previously given good results, became almost unfit for use, principally by reason of a great decrease in the amount of manganese. At one time this would probably not have been considered of such vital importance, but the fact has recently been well established that a certain

thermal tests cannot be made until the wheels are taken out of the annealing pits, a period of from five to eight days.

But this is not all. These tests are intended to show us quickly what kind of service we may expect from our wheels when under the cars, and the records of the life and failure of wheels in service are of the utmost importance. The actual mileage of a wheel under a freight car is a difficult thing to obtain; that is, it requires considerable labor, especially when the number of wheels in use runs up into the hundred thousands. For

this reason the life of wheels is often kept by months; and while this does not take into consideration the time spent in the repair yard or on the side track, it has the advantage of being very easily obtained.

As new wheels are made, the foreman of the foundry makes a daily report, giving the wheel numbers and the mixture used. The former are entered in a book which contains the serial wheel numbers, and the latter are entered in another book which later has the result of the drop and thermal tests recorded, as well as the depth of chill, shrinkage, etc. When the wheels are mounted on the axles a report is made weekly of the numbers and place at which this work was done, and this is entered in the book with serial numbers. Each week a report is also made from each point at which wheels are scrapped, giving the number and the cause; and when these are also entered, we have a complete record of dates and places of the "birth, marriage, and death" of each wheel.

This record is a most interesting one, as it gives the service which the wheels perform, and in looking over some it is at once apparent that a large number of wheels are always damaged by improper handling or usage. The proportion of slid-flat wheels has been very large heretofore; we hope that the more general use of air brakes will effect an improvement in this line. Chipped flanges and worn flanges are also not generally chargeable to the wheels themselves.

What most interest the founder are those which are scrapped for cracked plates, cracked brackets, and broken-to-pieces, as these show improper manufacture in the majority of cases. As the Master Car Builders' regular guarantee is for forty-eight months, all wheels which run over five years may be considered as giving good service; and if these wheels can be obtained, the study of their analysis is very beneficial. Therefore, wheels giving a very short service or a very long one should be carefully inspected and analyzed, as they will show the bad and good features in a much more forcible way than drop or thermal tests. Mr. W. W. Davis, chemist of the Norfolk & Western Railway, who with the writer has given much attention to this subject, analyzed a large number of wheels giving a long or short service or tested by the drop or thermal methods, and we present the results of some of his work:

Analyses of Car Wheels.

	Which Stood Thermal Test for 60 Minutes.		Which Stood 40 or More Blows Drop Test.		Which gave 5 or More Years of Service.	
	Max.	Min.	Max.	Min.	Max.	Min.
Graphite	3.28	2.65	3.31	2.65	3.18	2.23
Combined carbon	.95	.32	.90	55	1.24	.56
Silicon	.75	.50	.70	.50	.94	.58
Manganese	.53	.20	.46	.21	.34	.13
Sulphur	.088	.055	.086	.040	.085	.047
Phosphorus	.48	.35	.52	36	.49	.25

It will be seen that these limits are rather wide, but below are given what are considered to be the desirable limits for the chemical constituents of wheels:

DESIRABLE WHEEL ANALYSIS.

Graphite	2.75	per cent	to	3.00	per cent.
Combined Carbon	.50	"	"	.75	"
Silicon	.50	"	"	.70	"
Manganese	.30	"	"	.50	"
Sulphur	.05	"	"	.07	"
Phosphorus	.35	"	"	.45	"

By comparing the above with the analyses of a large number of wheels it was found that these limits excluded those which broke through rim in ten minutes or less under the thermal test; broke with twenty blows or less under the drop test; or gave less than two years' service. This last is important, as a wheel can easily be made to stand strains, but the wear will be unsatisfactory, and the metal must have enough chill to stand the abrasion of the track. It is possible to obtain a chill three-quarters of an inch deep on the tread with these proportions.

The analyses of seven wheels which had given from eight to eleven years service each had the following limits:

Graphite	2.56	per cent	to	3.10	per cent.
Combined carbon	.63	"	"	1.01	"
Silicon	.58	"	"	.68	"
Manganese	.15	"	"	.27	"
Sulphur	.05	"	"	.08	"
Phosphorus	.25	"	"	.45	"

Fig. 3 shows the comparisons between chemical analyses of pig iron and of the test

bar made by remelting the pig in a cupola by itself. Twenty-seven different irons were examined in this way. The solid line represents the analysis of the pig and the broken line that of the test bar. It will be seen that phosphorus remains constant, as does silicon when present in quantities under 1 per cent, whereas some of the manganese always disappears. The total carbon remains the same, but the proportions of graphitic and combined carbon seem to vary in an erratic manner. This is evidently due to the effect of the chill, as the analyses were made from the chilled test bars when possible, and the ance in enabling the wheel to stand the thermal test and consequently the strains from severe braking when in service.

Indeed, cracked plates are almost a thing of the past with foundries keeping the manganese up to the limits prescribed above, where previously much trouble was due to that cause. To overcome this it appears that one-quarter of 1 per cent should be present in the wheel. Ferro-manganese, however, seems to reduce the chill by increasing the graphitic carbon, as Fig. 4 will show, and this must be allowed for in proportioning the charge for the cupola. The combined carbon

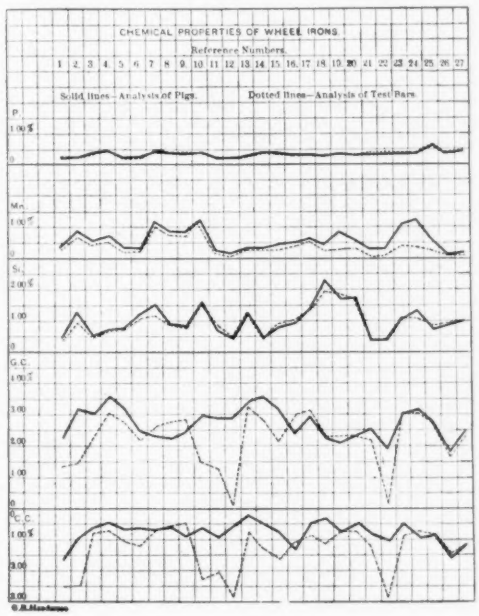

CHEMICAL PROPERTIES OF WHEEL IRONS
Reference Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Solid lines—Analysis of Pigs. Dotted lines—Analysis of Test Bars
P.
Mn.
Si.
G.C.
C.C.

FIG. 3.

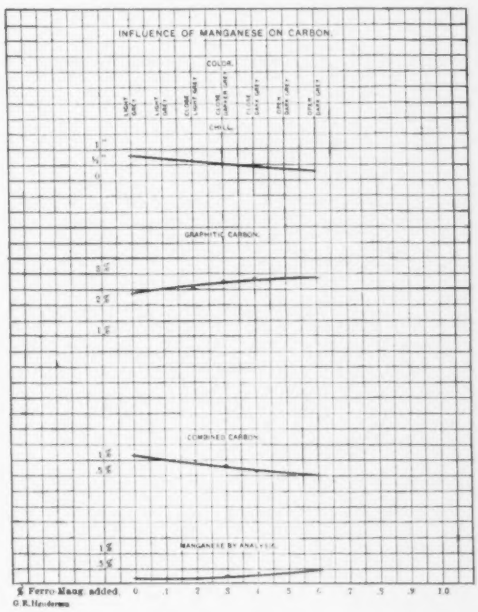


FIG. 4.

great increase in combined carbon in tests Nos. 11, 12 and 22 may be accounted for by the fact that they chilled clear through the two inches.

From the above it will appear that the metal charged into the cupola should contain more graphite, silicon and manganese and less combined carbon than are desired in the finished product. If the iron in stock is deficient in manganese, the proper amount can easily be added to the mixture in the ladle by the use of ferro-manganese containing about 80 per cent manganese, 13 per cent iron and 6 per cent carbon (combined). The use of large proportions of scrap makes this particularly useful, and it is of great assist- is partly changed to graphite, but not entirely in proportion to the amount of ferro-manganese used.

The experiments from which results Fig. 4 was constructed were made by filling small ladles containing different proportions of ferro-manganese from a large ladle which had been filled with the regular wheel mixture, and casting test bars from these small ladles. The effect of this is plainly illustrated both in altering the structure of the iron and the condition of the carbon content.

The material desired in a charcoal iron with chilling properties are those designated on the following page, the various grades to conform to the detail specifications.

The chill is to be measured in a test bar 2 inches square by 24 inches long, the chill piece to be so placed as to form part of one side of the mold. The actual depth of white iron will be measured. The white and gray portions should blend without a definite line of demarcation. The test bars will be made by melting in a small cupola several pigs of the shipment without admixture with other irons.

Grade.	Chill.	G. C.	C. C.	Si.	Mn.	S.	P.
2	¼ inch	2.50-3.00	.40- .90	1.25-1.75	.50-1.00	.03 Max.	.25-.40
3	½ inch	2.25-2.75	.50-1.00	1.00-1.50	.50-1.00	.03 "	.25-.40
4	¾ inch	2.00 2.50	.75-1.25	.75-1.25	.50-1.00	.035 "	.25-.40
5	1 inch	1.75-2.25	.90-1.40	.50-1.00	.25- .75	.035 "	.25-.40

The chemical proportions given above are the amounts of the constituents desired in per cents. and will be determined by the analysis of mixed borings in equal quantities taken from 12 pigs from each car.

In addition to the chilled test bars above mentioned, some unchilled bars of the same size will also be made. These will be placed upon supports 21 1-3 inches apart. A center load will be applied and the deflection measured. The bar should not break with less than 9,000 pounds, and the deflection at center with this load should not be less than 0.15 inch.

While charcoal iron is the principal ingredient in car wheels, it is often advantageous to use a small amount of coke iron, and the following specification is therefore submitted:

The material desired under this specification is an open-grain foundry pig conforming to and graded by the following detail specifications:

Grade No. 1.	Silicon	from	3.00%	to	2.50%
2.	"	"	2.50%		2.00%
3.	"	"	2.00%		1.50%
4.	"	"	1.50%		1.00%

Iron will be rejected which shows combined carbon below .10 per cent. graphitic carbon below 3.00 per cent. manganese below .50 per cent or above .80 per cent., phosphorous below .50 per cent. or above .80 per cent., sulphur above .06 per cent.

Should the silicon vary from standard grading, the next lowest grade under the specifications will be paid for, and should the silicon fall two grades low the material will be rejected. No higher grade is desired and no excess price will be paid for higher silicon. Samples of 12 pigs will be taken from each car, two from the top of each end, two from the middle, and two from the bottom. The borings will be mixed in equal quantities and the resultant sample represent the shipment.

Reference having been made to the drop and thermal tests, it may be well to conclude this paper with a specification for car wheels, which will give the details of these tests for ready reference.

The design of wheels must be such that they will be in accordance with the measurements shown on the drawings for 33-inch wheels, and also such that the wheels when cast shall weigh between 590 and 610 pounds. The tread and flange are to be identical with the M. C. B. standard section for same, and the flange thickness must pass the M. C. B. gauges for same.

Wheels must all be cast in true metallic chills of the same internal diameter and of uniform cross section. The body of the wheel must be of clean, soft, gray iron and smooth and free from slag and blowholes, and hubs must be solid and free from drawing. The tread and throat of wheel must be smooth, free from deep and irregular wrinkles, slag and sand-wash, and practically free from chill cracks and sweat. The depth of clear white iron must not exceed ⅞-inch at throat and 1-inch at middle of tread, nor be less than ⅜-inch at throat and ½-inch at middle of tread. Neither should there be a variation throughout the same wheel of more than ¼-inch in depth of chill. The blending of the white iron with the gray iron behind it must be without any distinct line of demarcation.

Each wheel must be so nearly circular that when a true metallic ring is placed upon the tread, and bears somewhere on the cone, it shall at no part of the circumference stand more than 1-16-inch from the wheel tread. No wheel made in a solid chill will be accepted whose circumference differs more than 1⅝ inches, or less than ⅞-inch from the circumference of the chill in which it is made. Wheels cast in contracting chills should not differ in circumference more than 2 inches from that of the chill.

All wheels must, during inspection, receive three heavy blows with a 6-pound sledge at

as many different points under the flange, between the brackets, without cracking flange or brackets. Each wheel must also be capable of standing a pressure of 50 tons when being mounted on the axle.

For each pouring of 100 wheels, or fraction thereof, two additional wheels must be furnished for test purposes.

These wheels shall be selected by the inspector, and subjected to the following test: One wheel shall be placed flange downward on an anvil block weighing not less than 1,700 pounds, set on rubble masonry two feet deep, and having three supports not more than 5 inches wide for the flange of wheel to rest upon; it shall be struck centrally upon the hub by a weight of 140 pounds falling from a height of 12 feet. Should this wheel stand 15 blows without breaking in two or more pieces, the lot of 100 may be accepted (as far as this test is concerned), provided that the broken wheel shows proper depth and uniformity of chill; also subject to return if the wheels do not satisfactorily stand boring and mounting, as explained above. Should the wheel break in two or more pieces with 15 or less blows, the lot of wheels represented by the one tested will be rejected.

The other test wheel must be laid flange down in the sand, and a channelway, 1½ inches wide and 4 inches deep, must be molded with green sand around the wheel. The clean tread of the wheel must form one side of this chamber, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top with molten cast iron, which must be hot enough when poured so that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. The time when pouring ceases must be noted, and two minutes later an examination of the wheel must be made.

If the wheel is found broken in pieces, or if any crack in the plate extends through the tread, the 100 wheels represented by the test will be rejected. Wheels may be dried before submitting them to the thermal test, but must not be warmer than 100 degrees Fah.

Philadelphia Foundrymen's Association.

The executive committee made the following report at the September meeting:

"This is our first meeting since the summer recess. A number of changes have taken place that are of interest to the foundry trade. The first is the rise in pig iron and scrap of from $3 to $4 per ton. This in itself must have the effect of advancing the price of castings to at least a like amount. In addition there has been an advance in the price of several other articles that has affected the foundry trade. For instance, plumbago, which is used to make foundry facing and blacking; steel wire, for making cleaning-brushes; bristles, for making dust brushes and scrubs; steel, for making shovels; riddles, tools and other articles; also coke and coal for fuel. Almost every article used in the making of castings has advanced. We call the attention of all foundry men to these matters that they may see how important it is to advance the price of their product in proportion. Second, there seems to be a scarcity of good molders, core makers, and pattern makers, which should also be taken into consideration. We find that through the instrumentality of some of the local foundrymen's associations in different parts of the country, they have actually made out a card price at which their castings should be sold. We find that Pittsburg and Milwaukee have taken advantage of the plan. There seems to be no trouble to maintain these prices. In fact, there is more work offering than there are foundries to do it. If you will stop to consider these facts, we think you will decide with us that the foundry business in iron, steel and brass is in a very prosperous condition. We find further that nearly all of our foundaries in and about Philadelphia have all they can do and a little more, to keep pace with their orders. While it is not the intention of this association to make a card price for either castings or labor we trust this may have the effect of encouraging the foundrymen to get their just dues."

In the discussion which followed the report it developed that there had been an advance in castings in all quarters in the past few months of from ½ to 1½ cents per pound, with prospects of further advances.

Referring to the scarcity of competent mechanics, J. C. Williams of the Enterprise Mfg. Co. said he had noticed that many workmen with less than a year's experience were posing as journeymen and demanding the latter's wages.

Mr. S. P. Cook, of the U. S. Foundries at Washington, advised that the foundries train their own workmen. He advocated a more thorough training of the apprentice, putting him through the different departments, and suggested that a letter be given him when his apprenticeship had expired.

A general discussion also took place on the way the price of iron was advancing and the chances for a continuance of this for some time to come. President Wanner expressed the opinion that no such re-action would take place such as occurred in 1880 when the price dropped from $42 to $25 per ton in a few days. As a further assurance that there will be no great drop in prices, the speaker cited the fact that in many instances, furnaces have sold their product up to July, 1900, and a few even to the end of that year.

Porosity and Shrinkage of Brass Castings.

BY WM. ROXBURGH.

To the article by C. Vickers, which appeared under the above title, I will add the results of some of my observations.

Although it may appear somewhat egotistic on my part to say so, I can regard some of the points at issue in no other light than bearing a direct relation to feeding, or the compressing of metals.

Position of casting has a great deal more to do with the successful production of castings than many imagine. More than a decade ago I had to do with the casting of some heavy brass chunks weighing about 1,000 pounds, say about 4.0″ by 2.0″ by 3½″ thick with a few oval cores interspersed of the usual bolt hole order, and as these castings had to withstand an extraordinary tensile strain, it was resolved to cast them in the vertical position, as by doing so it was considered that solidification would be more complete and that an improved metal for tensile resistance would be secured, but alas for vertical casting, it was a complete failure. After three successive attempts the vertical position had to be abandoned and not until those castings were cast on the flat or horizontally did success attend our efforts.

In casting these chunks in the vertical position, the top end had two gates not less than 3″ square and about 18″ apart, one being used as a pouring gate and the other as a riser. We were careful to use good hot metal and also to employ the feeding rod. We had hot metal standing by in a crucible to replace that lost by shrinkage, yet notwithstanding these precautions, feeding these castings solid had become an impossibility and usually ended with the rods being caught and held fast in the gates, the top end of the casting being a group of cavities of all sizes.

Very reluctantly the person in charge assented to change the position of casting to the horizontal. This, I held from the first to be the most favorable on account of brass having so much greater tendency to "draw" than iron. In this position the depth of the mold was only 4″ as against 48″ when casting vertically. Those figures being exclusive of flask and risers, which may roughly be reckoned as the same in either case. Hence it is obvious that the pressure is 12 times greater at the bottom of the vertical mold than of the horizontal. This will show the greater compression of the former method.

The details of casting these chunks in the horizontal position were as follows: The mold was placed on a level and six pouring gates judiciously distributed so that every part would be filled at one and the same time; the gates were about 1-¾″ in diameter and with a pouring basin large enough to admit of the ladle being almost instantaneously emptied. One or more risers were placed to assist in relieving the strain. No feeding was necessary with this arrangement, the method of gating being sufficient to feed the casting automatically.

I cannot at this time touch upon the other phenomenon, Mr. Vicker's article relates, but in the case of copper castings, may the swelling and the curling not be due to excessive temperature?

Inferior Soft Steel Castings.

Great advances have been made in the last ten years in the art of making soft steel castings so as to insure solidity and freedom from blow holes. In a statement made about the failure of Master Car Builders' car couplers by Mr. J. W. Thomas, general manager of the Nashville, Chattanooga & St. Louis, he says that scores of steel knuckles have been found so full of blow holes that they would not withstand the shocks of hard service. This is an old com-

plaint against steel castings, but it does not apply to firms who know how to make good steel castings. It applies to those castings made to sell at the lowest possible figure, cheap articles made without skill or knowledge of how a good casting ought to be made. A few years ago much indignation was excited in railroad circles by the information that certain railroad companies were making knuckles of cast iron to replace those broken on foreign cars, and the indignation excited by this dishonest practice was entirely justifiable. But today some concerns are turning out what they call steel knuckles that are no more reliable in service than the cast iron knuckles whose manufacture was repudiated as a palpable fraud.

It is a melancholy fact that years and years of experience has failed to convince railroad companies or their purchasing agents that a good article can only be bought by paying a fair price. In too many instances the purchasing agent accepts the cheapest article, regardless of quality, and the road pays dearly in the end for such as are not capable of withstanding the proving ordeal of train service. The sentiment is growing to require all articles purchased for railroad machinery to pass successfully through certain physical tests, but its progress is too slow for the best interests of railroad companies.

There are many firms in the United States that can make steel castings that are as reliable and sound, in small articles like a car-coupler knuckle, as the best forging ever turned out, and all that is necessary to purchase such castings is to pay a fair price for them. Those who purchase steel castings full of blow holes are merely engaged in a business of cheating their interchange connections.—"Locomotive Engineering."

A Jacketed Cylinder Head.

BY R. H. PALMER.

In making some castings, securing the cores by the use of Chaplets is not always advisable, and in the jacketed cylinder head, Figs. 4 and 5, the core was required to be secured without their use. In ramming up the drag, washers F, Fig. 2 were placed on prints O, Fig. 2, while pieces of gas pipe were rammed up in the drag, running from the washer to the bottom board through which holes were bored, but these were smaller than the pipe, to allow the pipe to rest on the bottom board.

After the mold had been rammed up and finished, pieces of gas pipe wound with strips of rags covered with thick blacking were set in the prints, resting on the washers. These pipes were cut just the righ length so as to leave the required thickness of iron at P, Fig. 2.

The core, B, Fig. 2, is set on these pipes, the former having an arbor consisting of two rings, Fig. 3, fastened together, the space between them forming the outlet for the vent of the core, the gases passing from

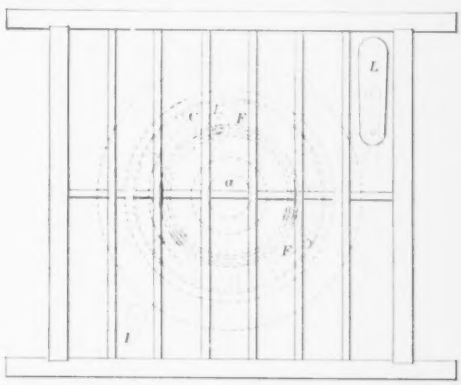


Fig. 1

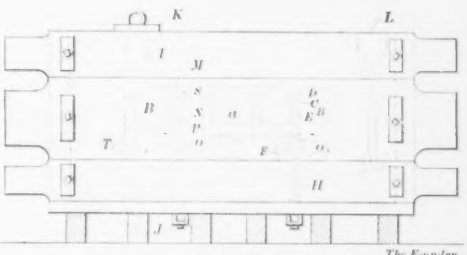


Fig. 2

the core to the gas pipes escaping down through the bottom board. When the cores are ready to set, the drag is raised and bolts passed through the arbor, gas pipes, and bottom board. Washers, Fig. 2, being made as the sides and bottom of a box with hole through bottom, are next put on, when the bolts are tightened, thus holding the core to bottom board, leaving room in the gas pipe around the bolt for the gases to escape. Two pieces of wood, the thickness of iron at P, Fig. 2, made by taking a piece of board the required thickness, and boring a hole in it the size wanted and then splitting the piece, are placed around the gas pipe, and the space

at N. Fig. 2 is filled with new molding sand and a few cinders placed around the nut, S. Fig. 2, this is covered over with a core sand mixture, to which is added a little new molding sand, wet with molasses water. A plate is heated and the three places on top of core are dried.

In rodding the core, outside of the arbor, wires and wood are used, the cast iron arbor is broken and removed through the hole shown at F. Fig. I. The pouring basin is made as L. Fig. 2 and Fig. I. three small gates being used which are easily choked and keep the dirt out better than one large gate. In the corner at T. Fig. 2, a good fillet is cut and riser I. Fig. 2, I. is churned to secure a sound casting.

Many times cores in castings can be bolted down, and bolt heads covered over and dried in engine work, but as it is much easier to set the chaplet, the latter method is oftener employed. For years it was the custom of foundries to make their own chaplets, and many a molder can look back and remember when the heat was kept back by the chaplets not being ordered as early as they should have been. In those days it was the custom to cover chaplets with red lead or chalk. Nowadays we can buy any kind of a chaplet wanted already tinned, so that the trouble with castings leaking around the chaplets has largely disappeared.

Even if a chaplet is tinned, it is necessary that the iron be poured hot to make a perfect union at these points of the casting. Many customers will insist, if a chaplet is buttoned, that the button shall be chipped off. This causes us to see less of these marks on castings than formerly, and this demand is also responsible for us finding out that if a chaplet is properly tinned and the iron poured a trifle hot, a perfect casting will result without marring the same with the blemish of a button.

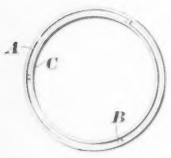


Fig. 3

Fig. 4

Fig. 5

Fig. 6

Limestone Consumed in Making Pig Iron.

Probably but few foundrymen realize the great amount of limestone annually consumed by the blast furnaces in producing pig iron.

The American Iron and Steel Association reports the following consumption of limestone for fluxing purposes by the blast furnaces in the United States. In 1897 in the production of 9,652,680 gross tons of pig iron it amounted to 4,247,688 gross tons, of which 3,680,666 tons were consumed by the bituminous coal and coke furnaces in the production of 8,464,692 tons of pig iron, 524,271 tons by the anthracite and mixed anthracite and coke furnaces in the production of 932,777 tons, and 42,751 tons by the charcoal furnaces in the production of 255,211 tons. The average consumption of limestone for the whole country per ton of pig iron produced in 1897 was a little over 44-100 ton.

The total quantity of limestone similarly consumed in 1898 in the production of 11,773,934 tons of pig iron was 5,275,819 tons, of which 725,729 tons wer consumed in producing 1,203,273 tons of pig iron made with anthracite and mixed anthracite coal and coke; 4,502,209 tons were consumed in producing 10,273,911 tons of pig iron made with bituminous coal and coke; and 47,881 tons were consumed in producing 296,750 tons of pig iron made with charcoal. The average consumption of limestone for the whole country per ton of pig iron made in 1898 was almost the same as in 1897, the figures being 448-1000 ton, or about 8-1000 ton more than in 1897. The average consumption of limestone to the ton of pig iron in the United States in 1897 and 1898 was a little less than 1-2 ton.

Everybody used to kick because prices were low. Now the majority are dissatisfied because they are high.

THE FOUNDRY

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The Detroit News Co. will supply the trade with THE FOUNDRY, through the regular channels of the American News Co.

We want to obtain examples of current foundry practice. Photographs, drawings and descriptive matter, showing just what is being accomplished in the foundries of to-day, will be cheerfully paid for.

We can not furnish a continuous set of back numbers beyond the current year.

Entered at the Post Office at Detroit, Mich., as second-class matter.

Trade Outlook.

Nothing has been recorded since our last issue which could in the least be construed as showing a lessened consumption. That prices have materially advanced during the same period indicates that those who refused to purchase earlier in the season are likely to be taxed for delaying to cover their requirements.

If an increase of furnaces will enlarge the production of foundry irons, this is likely to be demanded by new shops and the greater capacity of old ones, leaving supply and demand practically where they are now. It is estimated in the trade that about two-thirds of the producing capacity of foundry pig iron is already well sold into the last half of next year, while there is very little iron to be booked for the first half.

Of the different foundries, the malleable concerns appear to be pushed the hardest to fill the demands made upon them. Not a little delay has been caused many manufacturers of agricultural implements on this account.

Some Opinions From the Press.

It is a very favorite method nowadays for certain public journals to play to the "gods in the galleries." In raving over the advance in all kinds of materials these papers forget that supply and demand has a hand in fixing the price, and that without the abnormal rate of consumption now witnessed, prices would remain largely where they were two years ago.

If a foundryman desires to purchase foundry equipment he is likely to find half a dozen concerns who are willing to supply him. He will be asked a higher price than formerly, and yet there is competition to secure the order. The competition may not be as sharp as formerly, because increased demand has satisfied the manufacturers' hunger for work.

The Georgetown (Mass.) Advocate looks at the matter in this way:

"At the present time prices on many commodities are double what they were eight months ago, upon iron pipe, for example. The prices are abnormally high. With past free competition in such things the price would quickly work back to a normal level. With the trusts behind these things wherever prices go up unreasonably it will be much more difficult to work them down. The rush in business makes this a very propitious time for the organization of trusts with capital several times the value of the plants owned. As long as the rush in business makes it possible for the trusts to maintain their prices they will be able to declare dividends; but all dividends upon excessive capitalization are an injustice to the consumer. Trusts have come to stay. There is not any chance whatever that business will go back to its former condition of free competition."

The Advocate is evidently forgetting that the combination of pipe manufacturers must pay double the price for the pig iron they consume, and also higher prices for coke and other materials.

The Rome (N. Y.) Sentinel is apparently in better shape to see clearly in the editorial room, as shown in the following:

"Of course the high prices of iron cannot last forever. Pig iron, for which manufacturers were glad to get ten dollars a ton a year ago, is now selling for more than double that price. The price began to advance last December, and it advanced slowly until February, when an avalanche of orders excited the market sharply. Then prices were stationary for six weeks, and since then they have been advancing more. The cause very plainly is that orders have completely

outrun the possibility of supply within the desired time. All the trades that use iron are booming. The demand for agricultural implements has grown and steel rails are in enormous demand. It was predicted that the boom would last only until the coming winter, but the great foreign demand for iron keeps up, as well as the home demand, and leads good judges to believe the buoyancy of prices will remain well into next year.

Easily Excitable.

Rusk, Texas, Aug. 23.—Some four months since, stock was taken here to the amount of $20,000 to erect and operate an iron foundry. To-day, amid great enthusiasm, the first cast was made, in every particular a success. Dr. McCord, the president of the company, and Mayor Blevens emptied the first ladle, creating two pairs of most exquisitely designed andirons.

The Cavanaugh foundry is another added industry to Texas. It is thought to be the most extensive plant of the character south of St. Louis. There is no fear of want of patronage, as orders are filed ahead, the character of the metal used having been fully tested. Other and early developments are regarded as certain.—Dallas News.

What we should like to know, for sure, is who "created" those two most exquisite andirons? Which end of the shank did the doctor carry and which the mayor? And is there not a possibility that a third unknown party, to-wit, the molder, had something to do with the "creating?"

The Krank's Korner.

Advertising has made fortunes. It has made fortunes that never would have been made without it.

Any man who can turn out work a little better than the other fellow, any company that can turn out work at a less cost than its competitor, will find it to their advantage to advertise.

I am satisfied some foundries can turn out better castings than others. I know some can produce castings at a lower cost than their neighbors.

I have yet to see the first foundry that advertised.

It is true that several of them occupy space in different papers. That is all they do, too, and this is not by any means advertising.

Putting one's name in a paper and paying the printer's bill is not advertising at all.

Advertising consists in describing one's product in such a way as to create a demand for it.

To develop this demand one must have the right goods at the right price. To advertise these is simply to tell the truth about them.

I append several samples of what some foundries consider advertising:

THE SESSIONS FOUNDRY CO.,
BRISTOL, CONN.

Main foundry room 250 x 150 ft.

IRON CASTINGS. High Grade Castings, large and small. To Order.

IRON CASTINGS.
Metal Pattern Making.
SEND FOR ESTIMATES.
NEW BRUNSWICK FOUNDRY CO.
NEW BRUNSWICK, N. J.

GRAY IRON CASTINGS.
FINE, CLEAN AND SOFT.
SATISFACTION GUARANTEED.
WM. M. CRANE CO.,
1131 and 1133 Broadway, N. Y. City.
Foundry, Peekskill, N. Y.

FINE GRAY IRON CASTINGS.
True as a die to every outline of the pattern.
High Grade Brass and Bronze Castings.
PRICES RIGHT.
I. S. SPENCER'S SONS, GUILFORD, CONN.

STUART R. CARR & CO
BALTIMORE, MD.
IRON CASTINGS
of every description. Bell and Spigot Fittings for water pipe. Special Flanged Fittings to order. Heavy and intricate cored work up to ten tons weight. Correspondence solicited.

Grey Iron Castings
UP TO 10,000 LBS.
Heavy and Light Brass Castings
General Machinery
Mining Equipment a Specialty
Middlesborough Foundry & Machine Co., Inc
MIDDLESBOROUGH, KY

GRAY IRON CASTINGS,
S. CHENEY & SON, - Manlius, N. Y.

I believe all of these foundries make good castings, castings that have some talking points. Maybe the best castings in the world, and nobody knows it, because their ads say nothing about their castings.

Looking at these ads, however, I fail to find a single reason why I should patronize these concerns.

They have got their name in the paper and that is all. As an advertisement their efforts are a complete failure.

Now, all of these foundries buy the best of materials, they employ competent superintendents and workmen. They make tests to insure that their product shall suit their customers, they leave nothing to chance.

I believe all of these things could be talked about to advantage. If these same shops had a customer in their office they would certainly talk about them. Why should they not do the same in their advertisements?

I believe people can be influenced to pat-

ronize a certain foundry just as well as a certain store. I believe further that the right kind of advertising will enable them to obtain a better price for their castings, providing their castings are worth it.

John Wanamaker never would have amounted to much in this world if he had just hung out a shingle saying, "John Wanamaker, Clothing." Instead of doing this, "Honest John" kept on talking about his clothing; he told people why his clothing was better than other people's, and the result everybody knows.

There is a chance to talk about castings the same way. There is a chance for foundries doing good work to obtain a select trade at fair prices through advertising.

If the owners of foundries can not talk natural about their castings in an advertisement they should get some one to prepare their ads who could. It might cost them a five or ten-spot to do so, but this would come back ten times over.

An Adjustable Pin.

By J. E. BEICHER.

It is the experience of most foundrymen that the best devised flask-pin or guide leaves much to be desired. This is not to be wondered at when we consider how

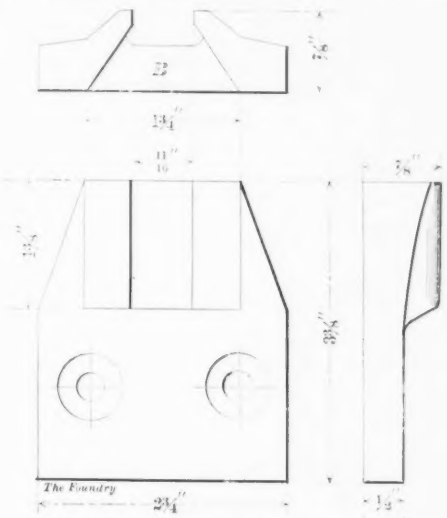


Fig. 1

flasks are handled and the rough treatment to which they are subjected.

It must have occurred to many that the constant replacing of flask-pins could largely be avoided if some means were provided to remove these as soon as the mold is closed. It is in shaking out that pins receive their hardest usage, not only from twisting the cope but from the sledge-hammer blows administered to same to help loosen the sand. It is obvious that this practice is bound to early disturb the nice fit and adjustment necessary to turn out

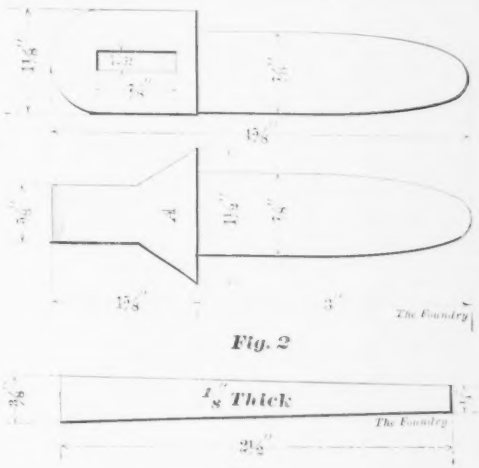


Fig. 2

Fig. 3

castings with perfect joints and also needed to secure good lifts.

The illustrations show in detail one adjustable flask-pin that is simple in construction, strong and durable. The dimensions given are intended for cast iron, when made of malleable iron considerable re-

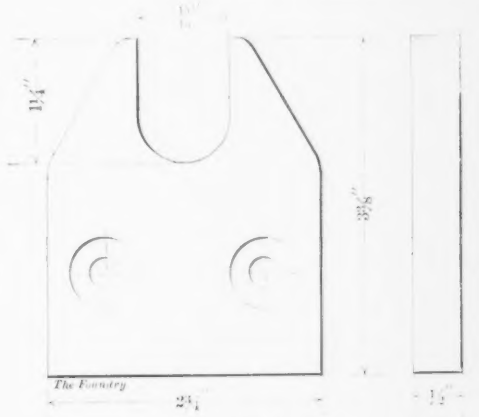


Fig. 4

duction in weight can be made.

Fig. 1 gives three views of the plate to be fastened to the cope of the flask. To this plate the pin, of which two views are shown in Fig. 2, is attached with the

wrought iron wedge Fig. 3; that part of the pin marked A Fig. 2, fitting into B Fig. 1. Fig. 4 shows the plate for the drag side of the flask in two positions. These illustrations are so well gotten up that with the measurement shown there is but little need of description.

The method of using these pins is to fasten the pin with wedge in one end of the cope, then placing the cope on drag, draw the two together until the pin fits tight in the groove in plate of the latter; the pin at the opposite end of the cope can now be inserted, adjusted and wedged in place. When the mold is finished and closed a light tap on the wedge removes same and permits pin to be easily withdrawn and ready for use on the next flask. In this way one pair of pins is sufficient for each molder, and added to this is the certainty that no pins will be broken at any time.

These pins have sufficient latitude to accommodate any probable difference in length of cope and drag, and will, when properly used, prevent all shifting of the cope. This style of pin has been in use for two years and can be made very cheaply, and almost perfect in a snap flask, requiring but little fitting before they are ready to use.

Cupola Designs.

The rules for the melting capacity of cupolas followed by builders of cupolas, blowers and fans are unknown to me, but the tables put out by the makers of blowers and fans are, according to my experience, under rather than over actual results. The capacity of a cupola depends so much on pressure of blast, its evenness, tuyere area, quality of fuel, iron, how prepared, charging of cupola, etc., that there can be a wide difference in results. An approximate rule, quite safe to follow, is to allow, with anthracite coal, 7 pounds of iron per hour per square inch of area of cupola; with Connellsville coke, 9½ pounds of iron per hour per square inch of area of cupola; this with a blast pressure of from 8 to 10 ounces per square inch in air pipe, and for cupolas of from 24 to 38 or 40 inches diameter inside of lining. This is below the actual performance of many cupolas. Especially is this true with two rows of tuyeres, and above 40 inches diameter. A 24-inch cupola, inside of lining, would, with above conditions, melt with anthracite coal 3,100 pounds per hour; with Connellsville coke, 4,275 pounds per hour. If iron is broken short, charged evenly, and snug, fuel is of good quality, and all conditions right, this, I think, is a low rating.

To those contemplating building cupolas the following suggestions may be useful:

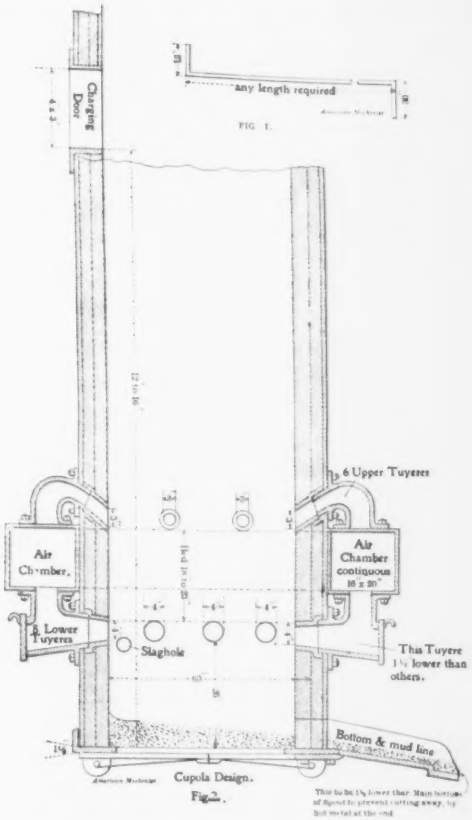
One and first is, do not build a cupola to line up to 24 inches unless it is for occasional use only, or unless it is to be put on trunnions, so it can be turned down to be chipped out or daubed up; 24 inches is too small to allow a man or boy to work inside to advantage. Twenty-six inches is the smallest size a cupola in frequent service should be made.

The combined area of tuyeres should be at least 25 per cent. greater than area of the blow-pipe. The tuyeres continue to be reduced in area during time of blast from start to finish. Tuyeres are better if made tapering, as iron or slag is easily removed from a taper tuyere, if they get into them, and get in they will. There should be one tuyere 1½ inches lower than all the others. This low one should be placed above tapping hole, with peek hole so made that the person tapping out can see clearly into bottom of this tuyere, that early warning may be had to tap out. It is better to have the shell sufficiently large for double lining as far up as charging door if possible. This costs no more to erect, or for trimming, and allows for easy enlargement of capacity at small expense and short notice. It is better to have the two lower sheets one-quarter of an inch thick, as they are subject to more corrosion, and sometimes if the lining gets thin or a brick falls out, the cupola will go through the heat if necessary and not burn through. Two rows of tuyeres, separated 16 or 20 inches, are good practice, notwithstanding there are many who think there is no particular benefit in this arrangement, but it certainly distributes the oxygen better, causing more complete combustion, generating heat higher up, and lengthening the melting zone, while more iron is melted with the increased units of heat thus obtained. The height of the first row of tuyeres above the bottom doors should be from 18 to 20 inches in cupolas up to 40 inches, and from 26 to 30 inches in cupolas up to 72 inches or more in diameter.

Amount of fuel on bed before charging: This is a point that nothing but try, try again will determine with exactness, and when found it will require constant watching and some little variation, as the best-priced fuel will vary in firmness when ignited, and the height of bed will have to be regulated to suit the character of the fuel, pressure of blast, etc. The safe rule to follow at first is to have the bed too high, rather than too low, especially with a new outfit. The height above lower tuyeres for anthracite coal should be 18 or 20 inches; with best Connellsville coke, 20 to 23 inches. If the blast pressure is low, say 6 to 8 ounces per square inch in blow-pipe, the levels given will be found high; if pressure is 12 to 14 ounces per square inch, they will be found about right; but to have bed too high is a good fault, and will be known by slow, but hot melting, and at the next heat the bed can be lowered, and in a few heats the best height and point to have the bed will be determined. And then the thing to do is to keep it there.

The amount of iron to be charged on the bed is from 400 to 600 pounds for every 100 pounds of fuel in bed, when this is put in even and with pig, in radiating lines from the center if possible. Then follow with a charge or fuel equal to about 10 per cent. of the amount charged in the bed. The bed and subsequent charges of fuel should be put in evenly and level. The next charge of iron can be the same, or nearly so, as the first, and so on through the heat; but, as before mentioned, changes can be made as practice and experience may suggest after a few heats are taken off. The one thing paramount to all others in cupola practice is to keep the fuel up to the point of best combustion; the more constant this is done, the better the results.

Charges of iron and fuel: If coke is used, the burden must be lighter than with anthracite coal for fuel, as it consumes faster, bulk for bulk. To get the height of the bed even, and to a certainty, from day to day, I have found a gage made of ⅝-inch iron (see Fig. 1) very useful. The length of long part should equal the height desired above lower tuyeres to 3 or 4 inches above bottom of charging door, and to be measured off before putting up the cupola bottom doors. When kindling wood is all burned out and fire going well, bring the level of bed up to height laid out by the gage, and proceed to charge the iron. A gage is more reliable than weighing of fuel, as there is considerable variation in bulk as per weight in different good fuels, and some days fuel is consumed more rapid leaving the bed either higher or lower in consequence. It is a very good plan not to put all the bed on at once, saving out a portion until about ready to charge the iron, then bring it up with fresh fuel to the gage marks, and variations in heat will be



much less, and a degree of certainty will be felt as to final results.

Fig. 2 shows a cupola of which two have been built, from my own plans, and they work well. I consider that this design has some advantages over the Colliean, especially in having less trouble with iron getting into the air chamber through the tuyeres. The design shown may be a little more expensive than the common plan, but the result is a first-class cupola easily taken care of.—L. C. Jewett, in American Machinist.

Blast Furnace and Cupola Practice.*

With a Discussion on the Use of Casting Machines for Foundry Iron.

By EDGAR S. COOK, Pottstown, Pa.

(Continued from September Number.)

We also find that atmospheric moisture plays an important part in the economy of blast furnace work. Roughly speaking, about five tons of air are required to make one ton of iron. Last June and July, 245 pounds of water in the shape of vapor was driven into the tuyeres for each ton of iron made, or over 125 tons of water in a week. The usual average for the year is about 160 pounds of water per ton of iron; but of course this varies with the location of the furnace, as well as the season of the year. The water is converted into oxygen and hydrogen gas at the expense of fuel in the crucible. Unless this is provided for, the temperature is lowered, sulphur in the iron increases, changing the relative proportions of graphitic and combined carbon, effecting the fracture and market value.

Cupola practice is affected in the same way, but to a less degree, because in melting iron, much less air is used per ton than is required to make the iron. It is, however, an important factor and must be provided for to guard against bad heats. We have also learned that coke, if exposed, will absorb from 10 per cent. to 20 per cent. of its weight of water. If coke is charged by weight, one day we may get 600 pounds of coke per barrow and another day 500 pounds of coke and 100 pounds of water, which is a poor substitute for carbon. On the other hand, different cokes vary in specific gravity, equal bulks varying 10 per cent. to 15 per cent. or more in weight. If the furnace is charged by volume, while the absorption of water is provided for, we are subject to violent fluctuations because of variation in actual weight of carbon, if cokes of different specific gravities are used.

All of these causes must be guarded against in blast furnace practice to insure uniform results and economical working, and the same causes apply more or less to cupola practice.

There are a hundred and one causes affecting the character and quality of castings produced by a foundry, other than the fracture, grade, or quality of pig iron used. Such being the case, it becomes all the more important to eliminate, by the application of scientific and technical helps, such of the disturbing causes as are within control. There has been so much written of late upon the chemistry of cast iron as applied to foundry practice, the influence of the several alloys, silicon, sulphur, carbon, phosphorus, etc., that it is not worth while for me to discuss the subject, however attractive it may be.

My object has been to call attention to causes of trouble that are not often referred to. Other causes will suggest themselves to every experienced foundryman, that pertain solely to the foundry, especially to the fine art of molding, designs of patterns, treatment of sand, pouring of iron, condition of cupola, volume of air, etc.

The furnace manager has his own troubles also. To one well acquainted with the cast-house work of a blast furnace the molding of the pig beds, the running or casting of the iron, and the physical causes by which the fracture of the iron is influenced, it has been a wonder that notwithstanding the advance in technical information, so much stress should still be placed, by our foundry friends, upon the accident of fracture, as governing the quality of the iron, to be used for any particular purpose. I do not question that the fracture is a guide to a certain extent, and the fact that it has been so long employed, in the absence of any better method, is proof of its old-time usefulness.

There is room for so many mistakes and errors, however, that have been developed only by the accumulation of hundreds and thousands of analyses, that it would seem that this custom should no longer stand in the way of improvements, that ultimately would prove of more or less benefit to the foundries. There are many causes affecting the fracture, independent of the composition. The fracture may be a reasonably safe guide to the blast furnace manager, especially if he has made a study of many analyses, comparing them with the physical appearance of the iron, and knowing the conditions under which the iron was made and cast. I do not know of any better pyrometer to determine the relative temperatures of the blast furnace, than the silicon and sulphur contents of the iron. The time of cooling, or rather of the passage from liquid to solid state, and the silicon con-

tents are exchangeable terms, the total carbon being constant.

Large masses cool slowly; graphitic carbon separates, even if silicon is very low. If the section of a casting is ⅛-inch or less, causing the hot metal to cool quickly, silicon must be high to compel or force carbon to assume graphitic form, in spite of the rapid cooling. When a furnace containing 40 or 50 tons of iron is tapped, under a blast pressure of 8 to 10 pounds per square inch, the flow of metal down the main runner, supplying the row of pig beds, may become unmanageable. The more rapidly the iron is run, other things being equal, the more open will be the fracture and the larger the proportion of No. 1X. We therefore aim to run foundry iron as fast as the men can handle it. Some beds may be sheeted or filled to overflowing, while others may only be partly filled. The large pigs will go into the No. 1X pile, while the smaller ones, from adjoining bed, may be piled at No. 2. Some of the beds may not be level; they may hang too much in one direction. One-half of the pigs may be filled to overflowing, and the balance only partially. The bed is cut off.

The iron seeks its own level, passing from one set of pigs to another. The flow of the iron disturbs the crystallization, so that the pigs first filled, and from which the iron flowed to fill up the others, will show a No. 2 or even a No. 3 fracture, while the balance of the bed, and the beds adjoining above and below, may be No. 1. The face of the pigs thus drained will show a concave surface, because of the metal being withdrawn from the interior, while the pigs receiving this iron will have a convex face. The foundryman condemns the one because its appearance indicates high shrinkage, while the latter is entirely acceptable.

The first three or four pigs in each bed, the pigs that fill first, will almost invariably be No. 2 or even No. 3 in fracture, while the balance of the bed may be No. 1, for the reason that the iron is not at rest, the movement of the metal, some molds filling up and then emptying partially, interferes with the law governing the formation of large crystals. Sometimes an obstruction in the tapping hole causes the flow of iron to almost cease for a few minutes. If a bed happens to be only half full, the fracture will show No. 2, while the preceding bed, run more rapidly, and completely filled, will be No. 1. Slow running is destructive to open crystallization, while rapid running and slow cooling is favorable to open iron, and a large percentage of No. 1.

Now, when we find that all of this iron is practically of the same composition, made under the same furnace conditions, and that the differences in fracture are due solely to physical causes, the fallacy of grading one pig No. 1, and another pig, only a couple of feet distant, in the same bed, No. 2 or even No. 3, becomes evident. Any inference that all the iron graded and sold as No. 2 and No. 3 foundry is sorted from No. 1 casts, and has the same composition as the No. 1, would be far from the truth. While it is true that a certain percentage of the lower grades show the same analysis as No. 1, yet by far the greater tonnage is made under different furnace conditions and will show different analyses. It sometimes happens that a foundry receives No. 3 grade, selected from a No. 1 cast, and finding that it answers the purpose just as well as No. 1, the buyer jumps to the conclusion that he will save considerable by using the No. 3, and places his order for a large amount. The next car received, while of approximately the same fracture, may have been made under different furnace conditions and be of entirely a different composition. Trouble follows and misunderstandings arise. Our pig beds are necessarily kept very wet, otherwise the cores will not stand. The molten iron is run 50 or 60 feet, in the main runner and subdivided into smaller streams into equally wet beds.

It has been noticed that the same iron run into chill molds, shows higher percentage of graphitic carbon than when run into the sand beds. This probably can be accounted for from the fact that the iron molds are dry and frequently warm. The following analyses, made by a chemist of Burnham, Williams & Co., will illustrate:

	Graph C.	Comb. C.	Total C.
Cast No. 81, drillings from sand pig.....	2.57	0.42	2.99
Warwick cast No. 81, drillings from pig cast in iron mold...	2.87	0.48	3.35

Full analysis by H. V. Wille, chemist, Burnham, Williams & Co., Dec. 30, 1895:

	Cast No. 81. Chill Molds.	Cast No. 81. Sand Pig.
Graph. C.	2.87	2.57
Comb. C.	0.48	0.42
Total C.	3.35	2.99
Manganese	0.42	0.41
Phosphorus	0.36	0.36
Sulphur	0.017	0.010
Silicon	1.50	1.52

However regular any furnace may be working, and however uniform in appearance any cast may be, there is an unavoidable variation in the composition of one bed of iron of any one cast, compared with every other bed, and a variation between the pigs of the same bed.

For some years past we have been sampling every cast liquid. The iron is taken from the main runner and poured into iron cups. The bottom of cup is 1 inch thick and the depth of liquid metal in cup is about 1 inch. These samples, as soon as they can be removed from cups, are quenched in water and drilled. The borings are mixed thoroughly, and analyzed. Frequently several analyses may be made for one cast, if any considerable difference is noted in different parts of the cast.

In order to secure practical uniformity, the different beds of a cast are broken over a block, the different pieces are then sorted and piled by fracture, and by the time they are again handled in loading a car, there is such an intimate intermixture, that the car as loaded is fairly represented by the cast analysis. We invariably get two grades by fracture, from each cast, sometimes three, so that we will have two or three piles of iron, No. 1, No. 2 and No. 3 foundry by fracture, all of the same analysis. Even in the same pig, the appearance of the fracture depends upon whether the pig is broken in the middle, close to the sow, or close to the end or point. The crystals are the largest nearest the sow, the end that cools the slowest, while near the point they will frequently be small and lighter in color, because of more rapid cooling. To strike a fair average we aim to break each pig in the middle. If the pieces are re-broken at the foundry, there will be found a considerable variation. The half next to the sow when re-broken may be open, while the other half may be close. The crystals in the sow are more open than those of the pigs in the same bed, as the section is larger and the cooling proceeds slower. Hence it is that some furnaces make pigs of large section to please the eye of the consumer.

Uniformity can only be secured by unceasing watchfulness, and the exercise of the greatest care, together with the help afforded by analysis. We have paid especial attention to uniformity of shipments, and while any one or two pigs may not show the same analysis, differing from one another, and differing possibly from the average of the cast, yet the cast analysis will fairly represent the iron as used in quantity. Uniformity can only be secured by selection, guided by analysis, and by intimate intermixture. Appearances are very deceptive, even to the furnace manager, with all the helps afforded by knowledge of furnace conditions. Every cast may vary more or less from every other cast of foundry iron. The use of iron by brands or names or grades does not furnish any guarantee of uniformity, unless there is selection and care exercised at the furnace. We are more or less dependent upon ignorant and inefficient help, subject to errors of judgment and of ignorance and carelessness, so far as grading by fracture is concerned.

We have recently been considering the adoption of a casting table. A favorable decision is necessarily dependent upon the favor with which such a departure from old methods will be received by our foundry customers. The mill consumers will offer no objections, but there is more or less doubt in regard to the foundry trade, especially the smaller class of foundries. I question whether there would be any pecuniary advantage to the furnace company, as the investment for one furnace would be so large as to counterbalance any possible saving in cost of handling our product in this way, as compared with sand pig. Our advantage would consist in doing away with the most arduous work around the furnace and at the same time enable us to ensure greater uniformity in our shipments and be less dependent upon ignorant and unskilled labor. In explanation of this statement, the following method of procedure will probably be convincing:

Upon tapping the furnace, the molten iron will be run into 20 ton ladle cars, a cast of 40 tons will require two cars. When the first car is filled, the iron will be poured into molds made of cast iron or plate steel, coated with loam or lime, to protect them and

insure no sticking. It is evident that the iron of the first ladle will be so intimately mixed by the filling and pouring, that each mold will contain iron practically of the same composition, which will be cooled under practically the same condition, hence the lot of 20 tons, pig for pig, will be more nearly uniform than is possible under the present method of running an equal tonnage into ten different beds. Each ladle will be sampled and analyzed, so that the composition of each carload of 20 tons will be definitely known.

The effect of the iron mold upon the fracture of the pig will probably be to tighten or close the grain somewhat, so that the present custom of grading by fracture would have to be modified to meet the changed conditions, or a system of grading developed depending upon the composition. For instance, an iron of 2.50 per cent. to 3.00 per cent. silicon and 0.02 per cent. or less sulphur would be No. 1.

Silicon 2.00 to 2.50.....No. 2X.
Sulphur 0.02 and under.....No. 2X.
Silicon 2.50 to 3.00..... No. 2 soft.
Sulphur 0.05 or less..... No. 2 soft.
Silicon 2.00 to 2.50..... No. 2 plain.
Sulphur 0.05 or less.....No. 2 plain.
Silicon 1.50 to 2.00.....No. 2 strong.
Sulphur 0.05 or less..... No. 2 strong.
Silicon 1.50 to 2.50.....No. 3 foundry.
Sulphur over 0.05.....No. 3 foundry.

In the absence of any grade number, specifications would call for the silicon and sulphur to suit the particular requirements of the purchaser.

If the pig iron was used directly in the form in which it comes from the furnace, that is, if the pig itself was planed and drilled, etc., the objection that the chilling action of the iron mold would harden the surface of the pig, might be valid enough, but as the pig is re-melted, this objection would seem to lose its force. Other things being the same, the temperature of the blast furnace determines the composition of the iron and the composition of the iron after being re-melted in the cupola, determines as a rule—occasionally apparent exceptions occur—the quality and fitness for any particular class of castings. Whatever may be the method of casting at the blast furnace, whether the iron is run into wet sand, dry iron molds, or granulated by running into water. In the latter case all of the carbon would be combined, and the particles, or pebbles of iron, would be white.

If the iron thus changed to white by rapid cooling, had been made in a hot furnace, and contained 3 per cent. silicon and not over 0.02 or 0.03 per cent. sulphur, upon re-melting in the cupola, it would make a soft gray stove plate or the lightest hardware casting, without any evidence of chill. This has been practically demonstrated.

Our experience with our sample chill cups, extending over many years, and representing thousands of casts and analyses, would prove that iron cast in metal molds instead of sand, will indicate to the purchaser, after a little experience, more accurately the quality of the iron for foundry uses than it is possible to gather from the fracture of any sand pig. We can guess approximately the composition of any cast by the appearance of the fractured chill cup samples, while we would go very far astray frequently if we relied upon the fracture of the pigs of the same cast, as the fractures vary so greatly, depending upon the sizes of the pigs, the manner in which the iron was run, etc. By comparing the chill cup samples, day after day, with the analyses, we find that the chill cup not only acts as a guide so far as the silicon is concerned, but is an infallable detective of sulphur.

Our pig iron, low in manganese, with 1.5 per cent. silicon and sulphur down to 0.03 per cent., will not take a chill in this cup. If the silicon falls to 1 per cent., with sulphur 0.02 per cent., there may be a slight chill, but let the sulphur increase to 0.08 per cent., a chill ½ inch in depth will show. Pig with 2 per cent. to 3 per cent. silicon, and sulphur up to 0.05 per cent., will not chill in the cup, but if the sulphur increases to 0.10 per cent., even 3 per cent. silicon iron will show a chill. The chill caused by sulphur is entirely different in appearance from that produced by low silicon and is easily distinguished. With pig of 0.50 per cent. silicon and low sulphur, the test piece 1 inch thick will show ½ inch chill. If the sulphur is high, say about 0.10 per cent., the test piece will be solid white. The most beautiful iron of No. 1 fracture is the low silicon and low sulphur variety, with high carbon. Such an iron, re-melted in a cupola and run into thin castings, would be white and brittle. Run into heavy castings, like ingot molds, it will be soft and strong, out-

lasting many times the ingot molds made of 2 to 3 per cent. silicon pig.

Our experience with the chill cup test pieces, showing the influence of sulphur, has enabled us to render more or less assistance in accounting for many of the troubles our foundry friends encounter. It is not common for the higher grades of the best makes of foundry iron to contain sufficient sulphur to be injurious, but in re-melting, if the cupola is not hot enough, or if the bottom is too cold to receive the iron, the absorption of sulphur from the fuel is frequently ruinous. Hot, high silicon iron, coming into a comparatively cold bottom, or tapped into damp and cold ladles, will undergo chemical changes, causing a white core, surrounded by a gray skin, that frequently causes the loss of many light castings.

Foundries, therefore, that operate on too small a scale to warrant the employment of a chemist, or large foundries, depending upon the analyses furnished by the furnace company supplying them with iron, can soon learn to judge sandless pig and determine the quality by inspection much more accurately than is possible with sand pig, however experienced and skillful the inspector. In purchasing a carload of sandless pig the buyer is sure to get as many pounds of iron as he pays for. It will not be necessary to melt tons of sand in a year, except as it may be found necessary to use it as a flux, and then it can be added in the shape and in the quantity that may be most convenient and economical.

The secret of success, in foundry as well as in blast-furnace practice, is to know enough to know how little one knows and how much there is to be known, by close application and hard work. I quote as follows from a recent letter of Mr. Thomas D. West: "You may not be aware of it, but the fact is that if one-half of one cast is run into sand molds and the other half into chill molds, the latter would give the softer iron when re-melted. Chilling of pig metal can only effect the state of the carbon. The silicon, sulphur, manganese, and phosphorus remains the same in both cases, so that as long as you have 2.50 to 3.00 per cent. silicon, and not over 0.02 per cent. sulphur in the cast, it matters not if the pig showed a chill, the iron would make a softer casting than had it been cast in sand molds."

As a matter of fact, it is extremely doubtful whether a pig iron with 2.50 to 3.00 per cent. silicon and 0.02 per cent. sulphur could be made to show a chill by casting in any iron mold. It would have to be run into water in order to cause sufficient carbon to assume the combined form and thus cause the iron to become white. When the blast furnace is making high grade of foundry iron, the atmosphere of the casting-house, when the iron is being run, is filled with kish or graphite, thrown off by the molten iron. The trough and sand runners frequently show graphite in abundance. When the molten iron is at rest in the beds, graphite can be noticed floating on the surfaces of the pigs. As the iron cools slowly, the graphite seems to accumulate on the surfaces, the quantity increasing the slower the iron passes from the liquid to solid condition. When the same iron is cooled quickly, as frequently happens when a bed is partially sheeted, and a thin layer spreads over the cores separating the pigs, this does not separate graphite. The quicker cooling seems to confine the carbon and keep it in the iron. Of course the graphitic carbon that exudes is washed off when the pigs are sprinkled with water and is lost.

The exudation of carbonaceous powder on the pigs is the more evident the lower the silicon contents, that is, with the iron carrying 1.25 to 1.75 per cent. silicon, the amount of carbon thus separated is greater than when the iron carries 2.00, 2.50 or 3.00 per cent. silicon. The face of this pig has a peculiar etched appearance, indicative of strong pig. A hot furnace, and consequently low sulphur, is a necessary condition. This fact may explain the assertion of Mr. West: Iron run into chills sets more rapidly than when cast in sand, which may thus act to retain the carbon.

The analysis of Mr. Wille, chemist of Burnham, Williams & Co., of cast No. 81, shows 3.35 per cent. carbon in the pig cast in chill molds, as compared with 2.99 per cent. in the sand pig. The same chemist made determinations of other casts of Warwick iron as follows:

Cast No. 83—	Sand Pig.	Iron in Chill Molds.
Comb. carbon	0.42	0.68
Graph. carbon	2.48	3.03
Total carbon	2.90	3.71
Manganese	0.40	0.51
Phosphorus	0.42	0.41
Sulphur	0.012	0.056
Silicon	1.52	1.24

Cast No. 91—		
Comb. carbon	0.49	0.54
Graph. carbon	2.03	3.01
Total carbon	2.52	3.55
Manganese	0.52	0.51
Phosphorus	0.38	0.44
Sulphur	0.010	0.010
Silicon	1.38	1.28

We have not run any iron into chill molds since the early part of 1896, and have no further data on this subject. Our carbon determinations are made from samples obtained by drilling the pigs, all other elements being obtained by drilling of chill cup samples.

Since my attention has been called to this side of the question, we have had time to make only a few determinations of carbon from chill cup samples, compared with pigs of the same cast, as follows:

	Sand Pig.	
	Cast 124.	Cast 132.
Graphitic carbon	3.40	3.59
Combined carbon	0.46	0.07
Total carbon	3.86	3.66
	Chill Cup Samples.	
	Cast 124.	Cast 132.
Graphitic carbon	3.58	3.64
Combined carbon	0.50	0.25
Total carbon	4.08	3.89

A distinction is to be made between iron run into chill molds, arranged in series corresponding to the beds of sand, and iron cast in molds arranged on a casting table, the molds being filled by pouring from ladle car. The uniformity pertaining to the latter method, pig for pig, will not apply to former, which are filled under the same conditions that apply to sand beds.

Baiting the Gullible.

BY CHARLES BUTTERFIELD.

Several years ago, when THE FOUNDRY was just getting a start in life, there appeared on the Kentucky side of the Ohio river a job lot of metallurgical bunko-steerers, who, under the name of The Hartsfeld Furnace & Refining Co., depended for a living on the number of foundry ignoramuses they could reach.

At the beginning of its educational campaign THE FOUNDRY gave them several hard raps at that time when they introduced "Bauxite Aluminum Facing" and "Nickel-Ferro-Aluminum Pig Iron" at a good profit to themselves and no earthly use to those who patronized their preparations. There is one thing these people must be given credit for and that is their ability to invent names as long as those of Russian dukes. They also used to have the faculty of attaching the names of prominent foundrymen to their testimonials without the former's consent or knowledge.

About four years ago I came across a blotter which carried an advertisement of the "Eureka Portable Crucible Cupola Furnace." The name in itself was enough to attract attention, and I put the blotter in my pocket, thinking it was the dying gasp of The Hartsfeld Furnace & Refining Company. Besides the long heading several illustrations were attached, the first one of these showing a rawboned individual about fifty years of age and another younger person, equally angular, whom I learned later was the son of the former. Between them they carried, what looked to me like a good sized lard pail, but which was explained to be the Eureka Portable Crucible Cupola Furnace. The following conversation then takes place on the blotter:

Father—"Now, my son, I have a Portable Eureka Furnace. Let us start our own brass and steel foundry on a small scale. We have earned thousands for the bosses at starvation wages and made them rich."

Son—"I am with you."

After these two people have turned their back on their employers, so to speak, there follows a great lot of padded information about the operation of the furnace, which is, judging by the size of those who carry it, about fourteen inches high and ten inches outside diameter, and is provided with a slag spout and other conveniences found on furnaces that are not portable. From the blotter it is learned that these lard pail affairs are also water-jacketed and that a patent has been secured on the whole outfit in several foreign countries.

In order to have the thing work right the reader is advised to use three per cent of aluminum alloy composite or aluminum steel pig iron, which The Hartsfeld Furnace and Refining Company is willing to let him have at the rate of six cents a pound.

This happened away back in '95, and I thought the concern had died a natural death, as it should have done, when the

Hartsfeld Furnace and Refining Company, of Newport, Ky., turns up on the banks of the Mississippi at East St. Louis, Ill., as the Denverside Smelting and Refining Company, and if I remember right the "Age of Steel" was taken in to the extent of writing up another water jacketed furnace with a long name on which a patent had meanwhile been secured.

This was a couple of years ago and I had about made up my mind that the gullible portion of our population had been reduced to such an extent as to cause the demise of these metallurgical humbugs when the advertisement below appeared in the "Railway Master Mechanic" and "Aluminum World."

Durango, Mexico, July 1, 1899.

To the Superintendent of the Foundry Department:

Dear Sir: It will give us pleasure and you satisfaction to allow us to express to you a sample keg of hundred kilos of our new Ferro-Nickel Manganese Calcium Fluoride for trial in cupola and ladle use. This alloy, like yeast, not an expensive article, gives new life to the metal in purity, ductility and softness. Upon receipt of this, please telegraph at once to our exclusive sole agents, Messrs. Stahlknecht y Cia, Bankers, Durango, Mexico, for a trial sample keg alloy, which we will be pleased to forward to you immediately by Wells, Fargo y Co.'s Express direct to your foundry. Awaiting your immediate reply, we are your faithful servants,

THE NATIONAL ORE AND REDUCTION CO.

Durango, Mexico, P. O. Box 83.

It will be noticed that the name of the alloy has grown until it wears whiskers. No more virtues are claimed for the alloy than when its name was less pretentious. The advertisement contains sufficient Spanish to make one think of hot tamales.

Another advertisement of the same alloy with its Calcium Fluoride Appendage removed also appears in the Ohio Valley Manufacturer, and is reproduced herewith.

Ferro-Nickel Manganese,

For Cupola, Crucible or Ladle use, is the only low priced but high grade alloy that does convert hard white iron into soft, ductile steel castings.

A sample of 100 pounds will be shipped for trial to any responsible foundryman by the

National Ore and Reduction Co.,
Durango, Mexico.

FERRO-NICKEL MANGANESE is made from high grade nickel and manganese obtained from the Durango Iron Mountain, and is prepared for use under processes covered by Mexican and United States patents.

STAHLKNECKT Y CIA.,
BANKERS, DURANGO.
Exclusive and Sole Agents for the Mexican Republic

United States Patent Rights for sale.

HOWARD CHEMICAL WORKS,
Howard Sta., St. Louis Mo., U. S. A.

The reader will observe the reference to yeast is left out and in its place is the claim that it converts hard white iron into soft, ductile steel castings. The information is also vouchsafed that it is obtained from the Durango Iron Mountains. So far as known no steel works have yet discarded their furnaces or converters.

What puzzles me is the way Stahlknecht y Cia go about advertising their "great" alloy. Probably they know better than to try and reach the foundrymen through legitimate journals. I don't think for a moment that a paper published in the interest of Railway Master Mechanics is the proper medium to reach the right people. This much-named alloy, flux, or whatever it is not, is meant for iron and steel works, and yet its promoters keep away from papers reaching these people. I append another advertisement taken from "Heating and Ventilating":

Ferro-Nickel Manganese

is adopted by four National Governments, twenty-eight Railroad Companies, and most up-to-date, progressive foundries in Europe as well as in the United States. Several Arsenals have given Ferro-Nickel Manganese a hearty indorsement, because it is manufactured entirely on scientific principles and claimed to be

Absolutely the Best Flux

for fluidity and the foremost in ductility and softness of the metal. Price 10 cents per pound U. S. Cy.

Beware of imitations or alloys sold at double or triple this price.

Apply for Directions, Catalogue and Testimonials to

THE NATIONAL ORE & REDUCTION CO.
Sole Manufacturers, DURANGO, MEXICO.

LA COMPAGNIE FRANCAISE DU METAL DEPLOYE
(French Expanded Metal Co.), PARIS, FRANCE.

REPRESENTATIVES:
Stahlknecht y Cia., Bankers, Durango, Mexico.
Exclusive Agents for Republic of Mexico, Cent. and So. American Republics.

HOWARD CHEMICAL WORKS Howard Station Agents,
St. Louis, Mo., U. S. A.

Judging from the following item taken from the Paducah (Ky.) Register, these Furnace & Refining, Smelting & Refining, Ore & Reduction people are evidently yearning to camp in old Kentucky again:

"The Register is in receipt of a letter from the secretary of an Ore and Reduction Company in Mexico, stating that the directors of that company have decided to establish a manufacturing plant at or near Paducah.

provided favorable inducements can be obtained.

They propose to manufacture a new patented alloy, Ferro Manganese, used in foundries. They claim to have contracted for the machinery for a twenty-ton daily plant, with an Ohio firm, and that it will be ready for delivery September 5. The concern says they mean business. The letter will be turned over to the Commercial Club for investigation and to see what inducements those people want."

The Paducah people had better go slow or they will have a white elephant on their hands. There is not enough fools in the foundry business to support a twenty-ton plant.

College Men as Molders.

During the vacation season a dozen college students have been working in the shop of the Builders' Iron Foundry Company on Codding street. Now that the college term is about to commence most of these students will go back to complete their course, but two of them will stick to the trade.

Molding and the work in an iron foundry is considered about as hard a trade as there is. The fact that some college-bred young men are going to continue at it, after a trial of several months, is certainly encouraging and is causing no little amount of comment.

These young men were about the average college boys. They were taking mechanical courses, and during the vacation period an opportunity to get some practical knowledge of the iron art was offered them by the Builders' Iron Foundry.

When the college boys arrived in Providence and went to work in this foundry, the molders laughed. They said that the students would not be able to do the work. More than this, the molders asserted that as soon as the boys found out how hard the work was they would quit anyway.

When these men spoke of the hard work that a molder has to do they knew what they were talking about. They had all rammed sand, lifted the heavy molds, worked amid the half darkness and soot of the foundry, carried hot iron, poured, inhaled the noxious gases, suffered in the swelter of a "heat" when the thin red stream of iron seemed to flow forever from the cupola—had been "sand rats" for a score of years.

The molders knew all this, and more—that young men, unused to long hours of labor, but accustomed to study and leisure, would find the change more realistic than pleasant. It was dollars to doughnuts that the college-bred boys wouldn't make good sand rats.

All through the heat of the summer these college boys have worked in the foundry. They have dropped their time check into the box before 7 o'clock every morning, and have quit at 6 o'clock each week-day night. With rammer and shovel, lifter and finishing trowel, they have worked in the black sand. They have carried the ladle with the golden molten metal, and stood in the steam and heat when the blue gas lit up the smoky surroundings. They have seen the yellow fade to a rich red, and felt the blistering radiation from the hot casting after the heat was finished. And some of them liked it, for it was work.

Education is what these boys were after. In college they had studied the chemistry of iron. Theoretically they knew all about castings and making them. This experience was what they needed to give them some practical knowledge of the subject.

Technical schools in England have foundries, some of them where ten-ton pieces may be cast, and are cast by the students. At the Yorkshire Technical College the men who are learning the iron business have to take a three years' course, part of which is in the foundry.

This dozen of college students came from several different colleges. There are representatives there from the mechanical course of Brown University, New York University, Urbana College, Illinois, University of Maine and Tufts College.

In passing through the shop a Journal man looked over the workmen there and tried to pick out the college boys. There were a number of apprentices and young men working industriously. All were in working garb, cloth that had become the color of sand and soot. Faces matched the clothes, here and there a bit of the flesh color faintly seen through the foundry color. All the men looked alike. Only one "B. U." hat, once white and brown, served as an identification mark. As far as outward appearances went the college boys had lost identity.

How they liked the work is another matter; also what their employer thought of them. One of the head men of the company who has followed the matter closely stated that there was a big variation in the young

men. Some would make molders and some would not. On the whole, they had done fairly well, each one working with an experienced man. The boss had treated them the same as any employe.

This man is himself a technical college graduate and occupies an important position for a man of his years. He said that there was an opening for just such college students as were learning the first principles of molding. He had never heard of any college men going into the foundry before. It was considered undesirable work, but there was plenty of reward for a man who knew both the technical and practical part and had the experience that manual skill alone could impart.

Many of these students would have worked somewhere during the summer to obtain a little money to help them through the winter months at college. The pay at the foundry has been better than they could have made in many situations, and they have been acquiring a practical insight that will be valuable in after years.

It is said that one of them has advanced a good deal in learning the trade. In fact, so well did he acquire skill in molding, that he tried to make a casting on his own hook. As a matter of record, he used a silver dollar of the date of 1848. The result was so satisfactory that it was offered at a soda-water counter, but he paid for the soda with a quarter.

Of course, none of the boys claims to be a molder, for it takes four years' apprenticeship to become a journeyman. But they have had an opportunity to learn something of this trade that under ordinary circumstances few men way up in the iron business ever have had.

There is every probability that at least two of these college men will stay at the trade. Whether they are enamored of it or not does not matter, but they are apparently satisfied that the education they have received will help them in getting a position after they have learned the business.—Providence (Rhode Island) Journal.

Effect of Carbon in Changing the Grade of Mixtures.

BY THOS. D. WEST.

In the article on "Dividing the Authority," by Mr. W. H. Kane, seen in the Aug. number of THE FOUNDRY, the writer is quoted as saying that "carbon should be wholly ignored as far as general foundry practice goes."

The writer is not aware of having made a statement that would embody the sense of the above sentence when standing alone, as given in Mr. Kane's article. With all the other metalloids constant, an iron having 4.50 carbon and another with but 2.50 is sure to make a difference in the grade of a mixture. Where a foundryman is obtaining iron of one particular brand or grade from one furnace, using the same fuel ore and flux, then the carbon can be ignored as the little carbon may vary in iron made under the above conditions, will, as a rule, cause but little if any difference in the grade of an iron for general foundry practice, or the common run of unchilled castings.

How Molders May Become Patternmakers and Draftsmen.

BY AARON FRANKENHEIM.

The connection between these three trades is obvious. It does not consist in the similarity of their duties, for these are very different. The pattern maker works from drawings or designs furnished by the draftsman, and the molder works from patterns furnished by the pattern maker.

If a molder can read drawings he can become a pattern maker. For a good molder's qualifications are such as to understand the construction of a pattern. First, he knows how a pattern is molded, and fully understands the draft of a pattern, and this alone and a little practice of the handling of tools will make him so fit as to become a successful pattern maker.

Molding is honorable work, and requires no small degree of ability. We all admit that molding is hard and dirty work, but it requires some thought and intellect as well as labor.

There are many molders who think that as long as they are making a living that is all they wish for, but it is just these men who are satisfied with their positions that never get ahead; these men will remain all their lives where they are. Now, on the other hand, some molders will consider their positions and strive to get ahead. Those are the men who will fit themselves for a higher

position in life, and their success is certain.

At present it is almost impossible to get along without mechanical drawing, for drawing is the language of the mechanic. When a firm gives out a contract for some iron work, they have their draftsman make drawings of such, and if the pattern maker cannot read drawings, why, he may as well throw up the sponge, or in other words, quit.

A pattern maker is the man who is in the closest connection with the draftsman, for really every pattern maker is a draftsman, but every draftsman is not a pattern maker. I have always found it so. For instance, a gentleman came into the shop and wanted some patterns made, and could not furnish drawings for the reason that he was not capable of making them, but he could express his ideas so that I could understand what he wanted. I then made a working drawing and the patterns, but it took a great deal of changing to suit him. Now you can judge how important mechanical drawing is, because when a pattern maker receives a drawing he works on certainties, and is not bothered with altering and changing.

Take this same subject from the financial standpoint. The way of working from drawings is far cheaper than working from ideas, which a man gives a pattern maker, for there is always some extra work on such jobs, and consequently the man has to pay for the time it takes.

Molders, in order to learn drawing so as not to interfere with their work, should go to evening schools where drawing is taught. The correspondence system of instruction is very good, but I do not think it advisable for a beginner to take lessons by correspondence, because he should be shown by an instructor who could early correct wrong ideas. Drawing by correspondence may, however, be taken by one who has been over the elementary part of it.

A pattern maker can become a draftsman easily, because he understands how to read drawings and make them, and the rest required is calculations and an idea of machine construction. These come almost natural to him, because he has already had many drawings to work from.

As for the molders, to become successful foremen, pattern makers, draftsmen, and shop owners, they should learn drawing, and success is then all the more certain.

Price List of Castings.

About the greatest obstacle in the way of foundries reaching a uniform system of bidding for work is the lack of a proper classification for the many different kinds of castings turned out. Two castings may have exactly the same weight and be molded in an equal length of time, yet if one of these must finish clean all over and maybe stand a certain pressure or be rejected, who will say that such a casting is not worth more per pound than another casting that is not subject to such requirements?

An insurance company charges a premium according to the risk it assumes, and foundries surely ought to charge more for castings, that must come up to certain specifications than for those that are accepted without a test of any kind. Many of the discrepancies to be found in different bids are simply due to the bidder neglecting to take into consideration the amount of risk he assumes.

The Milwaukee Foundrymen's Association, through its president C. A. Sercomb and Secretary Thos. Sheriffs, has started what may be called an educational campaign on this subject, which is likely to have far-reaching results, and to at least exert a moral influence upon those who have been in the habit of bidding on work in the dark.

We publish below the classification of castings as adopted by the Milwaukee foundrymen. It begins with the provisions that on trial castings, time is to be charged at 50 cents per hour, iron 3 cents per pound, the foundry not to stand loss from warping or bending of long plates and moldings or from poor patterns, and time on patterns to be charged at 50 cents per hour. The classification and price list complete are as follows:

ARCHITECTURAL.

	Cents per pound.
Columns, 500 pounds and under, faced	4
Columns, 500 to 1000 pounds, faced	3
Columns, 1000 pounds and over faced	2½
Column plates, bolsters, post caps, bases, wall plates, wall anchors and lintels. Machining extra	2½
Cresting	5
Sill plates, step plates, platforms and risers, stringers, sidewalk tiles and frames, sidewalk rings and covers	3½
Ornamental work, fascia, shell caps and bases, moldings, etc., not less than ⅜ thick	3½
Above, less than ⅜ thick	4
If above is for plating, additional	1
Fence posts and post caps, ⅜ thick	4

Sash weights 1¼
Sash weights, special..... 2½

AGRICULTURAL.

Frames, gears, boxes, pinions, etc..... 3
Fanning mill castings..... 3
Air brake casting.....3 to 4½
See bench list for light castings.

BENCH WORK.

Under 2 pounds, per flask by the piece.
Long orders, 2 pounds..... 5
2 pounds and over, per flask..... 4
Job bench work.....4 to 10

BOILER SHOPS.

Grate bars, boiler fronts..... 2½
Buck stays and all castings..... 2½
Rocking and shaking grates and fittings (extra) ..... ½
Above, to consumers direct (extra)..... ½
Fitting fronts (extra)..... ¾
Use of foundry patterns (additional)..... ¼

BRICK YARDS.

Grates, see boiler list.
Dampers and brick machinery..... 3

BRIDGE CASTINGS.

Bridge castings for city repairs from old castings 3½
Bridge wheels, chilled or turned, for repairs 3½
Large orders (machine work extra)..... 3
Bridge work castings at architectural list.
General price for bridge shops..... 2¼

ELECTRICAL.

Dynamo 3½
Small parts of same..... 4

ELEVATOR.

Weights 1½
Hydraulic cylinders 3½
General elevator castings..... 3

FURNACE.

Fire pots 6
Other furnace castings..... 6
Furnace repairs .....6 to 10

GAS AND GASOLINE STOVES.

Gas and gasoline stove castings.....4 to 6

LAWN FURNITURE.

Settees 4½
Vases .....4 to 5

LARGE MACHINE SHOPS, ENGINE AND PUMP CASTINGS, HEAVY.

Dry sand and loam work..... 3½
Green sand .....2¾ to 3
Fly wheels .....2 to 2½
Cylinders .....3½ to 4½
Ammonia castings .....6 to 8
Electric crane castings, heavy, 100 pounds or over 2¾
Electric crane castings, light, 100 pounds and under .....3 to 4
Rolling mill castings 2½
Bed frames 2½
Wheels with flange..... 2½
Castings made off one-half pattern (extra) (refers to cylinders)..... 1¼

MACHINE SHOPS. (JOBBING.)

Boxes, hangers, oil catchers, etc., and machine castings not required to be clean and without many cores, 50 pounds and under 3½
50 pounds to 100 pounds..... 3
Engine castings, except cylinders and other machine castings with cores, finished work, extra over above..... 1
N.B.—All work required to stand high pressure of air, ammonia, etc., to be doubled above list.

MISCELLANEOUS.

Manhole covers $9.00
Cents per pound.
Fire cisterns .....
Water pipe special fittings..... 3
School seats, fronts or backs..... 4½
Ink wells 8

STABLE GOODS.

Oat boxes, hay racks, stall partitions, etc... 3½
Above, ¼ thick or less..... 4
Barn gutters 4
Hitching posts 4
Horse weights .....1 to 2

STEAM HEATING.

Grates per list, see boiler.
Heating fronts and radiator stands and legs 3½
Heating boilers for steam and water..4 to 6
Water backs .....8 to 10
Heater bases for coils.....3½ to 5
Hot air blower castings.....3½ to 5

STEAM PUMPS.

Steam pumps castings, 6 inches and under.. 4½
Steam pumps castings, over 6 inches..... 3½
Flanged pipe, over 6 inches..... 3
Flanged pipe, under 6 inches..... 3½

STOVE.

Stove repairs .....6 to 10

WAGON AND SLEIGH GOODS.

Bolster and reach plates..... 2½
Rub irons 2¼
Sleigh shoe, knees and wagon brakes..... 3
Mandrels and swage blocks..... 2½
Sleigh shoes, car lots..... 1½
Sleigh shoes, less than car lots..... 1¾
Sleigh shoes, jobbing special patterns...2 to 3
Washers, ¾ inch and under, large lots..... 2⅛
Washers, over ¾ inch, large lots..... 1¾

WIRE WORK.

Wire work goods, see bench list prices.
N.B.—All stopping off and cutting in the mold, ¼ cent per pound additional.
Castings delivered within city limits free of charge.
Terms, net cash 30 days.

The people who a year ago were saying that iron could not advance two dollars a ton, without causing a reaction, have probably changed their mind by this time.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

SHORTAGE OF PIG IRON.

Its Influence on the Quality of Castings.

During the period of depression pig iron was cheap and the founder could get exactly the kind he asked for. The furnace had plenty of time to grade iron and was careful to ship the grade called for because it could not afford to stand any rebate on account of off grade. During all of this time the advocates of analysis made but little impression by their arguments, because with plenty of first-class stock the founder could feel reasonably certain of the good quality of his castings.

The founder made so little money that he took but a small interest in any kind of improvement.

Now all has changed, but the change has brought new complications. The founder has not been able to advance prices to keep pace with the advance in the price of pig iron and of labor, therefore his profit is not at all satisfactory. It would be more correct to say that this was so during the first part of the year, for at present each founder has more work than he can do and has to a large extent completed contracts taken at lower prices, and has advanced his prices so that profits are satisfactory. But now a problem of a very serious nature meets him. He cannot get the kind of pig iron he needs and can get but a limited quantity of any kind. It is only by tracers and all kinds of hustling that he can get iron enough to keep running, and quite often the small founder is obliged to borrow a car or a few wagon loads of iron to prevent the loss of a heat.

Worse than all this, he has to borrow what he can get and when he returns a like amount the lender has to take what is returned, whether it is the same as borrowed or not.

There is a scarcity of soft irons all over the country. Railroads are not able to deliver cars as wanted and founders find that they have irons that are too hard one day, but hardly ever enough soft iron. The rush of business and anxiety to fill orders with a profit, and the question of getting any pig iron at all takes all of the founder's time. Now is the time he needs analysis. If he could have a card containing the analysis of each car, or could know the amount of silicon that it contained, he would have a guide as to its quality, but unfortunately the furnaces are shipping the iron as fast as made and a card showing the analysis would in many cases show that the iron was totally unfit for the purpose it was to be used for, and for this reason the analysis is not furnished. The founder has no other iron and can get no other and must use this. He has no softener much of the time. He uses all the scrap he can get and the furnace wants all blame laid to the scrap or to other pig iron that was used along with theirs. There is no time for the founder to have a chemical analysis made of each car he receives.

These conditions drive him to the only other method to test the quality, viz., the measure of shrinkage of a test bar. It is a fact, that if the shrinkage does not vary, the quality does not vary, whatever kind of pig iron or scrap is used. If the shrinkage does vary the quality also varies, and the variation of shrinkage shows what will bring the quality back to the standard. If the shrinkage is more than is desirable an increase of silicon will reduce shrinkage and bring the quality of the castings back to the standard.

If the founder is compelled to use irons that are not to his liking the measure of shrinkage gives the quality of those irons.

A few days ago I was asked by telephone by a founder in a neighboring city how he could use all scrap for a few days, and how he could know whether his castings were injured, for he could not get any pig iron for a week, but had plenty of scrap in his yard. I told him that the only way to know whether he could do so was to compare the shrinkage of these castings with his usual mixture so as to have a satisfactory standard. The change in shrinkage afterwards would tell him how much scrap he could use. The present conditions make it necessary to keep a record of quality so as to be prepared for just such emergencies.

A few weeks ago Mr. Brundage, superintendent of The Gale Manufacturing Co., of Albion, Mich., told me that he had used the shrinkage test for the past three years, and had a record of the shrinkage and strength of his iron for each day, and could tell by the numbers on the machines sold exactly

the quality of iron in each, and that this had stopped all complaints regarding his castings. He said that the plan had worked to perfection.

Then there is another reason why a founder should know exactly the quality of the iron that goes into his castings, and that is if the shrinkage is right he will know that his iron is right and will look to other causes for defects. Lately I have had a number of castings sent to me with request for an opinion as to how to vary silicon to prevent the defects. In one case it was blowholes, and was due to mixing too much steel scrap in the ladle. The trouble was not with the mixture at all, but with the method. By charging the steel scrap in the cupola along with the iron the blowholes did not appear. In another case the trouble was scabbing, and was not due to graphitic deposits from too much silicon, but from too dense a sand and insufficient venting. In another case shrinkage spots were caused by improperly proportioned patterns. By reducing the size at that point or by coring out a portion of the iron at an enlarged part the defect could be remedied. In all of these cases it was supposed that chemical analysis would show that there was too little or too much silicon. If they had known that the quality of the iron was right they would have looked for a remedy in some other direction. A record of quality should be kept each day so that no one would think for a moment of blaming the iron. With the right kind of iron the percentage of good castings will be increased very largely. Watch your return overmelt and you will find it very much smaller if your iron is hot and fluid right along. It is better to use a little more coke if by doing so you can get a greater percentage of good castings. Don't look for something mysterious whenever anything goes wrong. The way to prevent this is to test the quality of your iron each day.

The Outlook in the Iron Trade.

Considerable force is added to what is said upon this subject in the current issue of the Engineering Magazine, on account of the author being Archer Brown, of Rogers, Brown & Co., who, as much as any other man in the trade, is doubly familiar with all the conditions of the past and present. An opinion from such a source, based on years of observation, is certainly entitled to great consideration. After reviewing some events in recent history of the trade the author asks, "Will it last?" to which question he replies:

Frankly, it must be admitted no man knows. It is not given to mortals to unlock the future. War, famine, pestilence, Bryanism, may intervene and upset all calculations. But the wise man faces the facts as they are before him, and builds his judgment on these, discarding optimism, pessimism, preconceived theories, and even tradition. There were never better settled or apparently sounder commercial traditions in the past than that $1 wheat, 10 cent cotton and $10 pig iron (at Birmingham) marked the bottom limits in great staples; but we became familiar with values scarcely more than half these, and men lived and prospered.

The simplest and largest fact in the present situation is a demand greater than the supply. What makes the demand? What limits the supply? The demand is great because seventy millions of people have pinched and economized for six or eight years, and are now quite able to buy, and what is of more consequence, are in a mood to buy. They have made the old stove answer, worn out the harvester and threshing machine, postponed the building of the county bridge, got along with the old stationary engine or lathe, put off the purchase of needed rolling stock for the railroad, hesitated to try conclusions with England in the building of ships, and generally have waited for the return of what is known as "good times." Now they want to replenish, from the sad-iron to the locomotive. Will they stop because prices advance? No, they will not. Here enters the element of human nature. Confidence breeds confidence. Distrust feeds on itself. Two years ago the great railroads of the United States could have renewed much needed equipment at about half the cost that to-day they do not hesitate to pay. Did they do it? It is notorious that the richest hesitated most. An amusing illustration is the case of a master mechanic of a great road whose requisitions underwent the usual cutting in two in the middle when they reached the management. Among the track and shop supplies needed was a large belt for an engine. When it came it had suffered the usual pruning, and was just half long enough to reach. The

writer will not soon forget an effort, in the summer of 1897, to find a buyer in New York for 100,000 tons of Alabama pig iron which a large interest was willing to close out at $6 a gross ton, duly stored in a warrant yard—a price unprecedented in the history of the world. Not one of the great banking houses of capitalists dared face the perils connected with such a proposition, though money was ruling at 3 per cent, and nearly free storage on the material was guaranteed. To-day almost any bank in New York would lend $15 a ton on it, and scarcely ask a question.

Buying, therefore, will not stop because prices are up. The railroads must have enormous additions to equipment, or lose the great harvest of profitable traffic. The millions of farmers will buy their agricultural machinery, stoves, carriages and pianos because crops have been good for three years, fetch good prices, the mortgages are paid off, and there is money in bank. Electrical equipment will not stop while street railways and lighting companies make large earnings, merely because dynamos and rails are dearer. Cities and towns will put in needed water and gas pipe without much regard to whether the cost is $18 or $28 a ton.

It is perfectly true that some new enterprises, that otherwise would take shape, are deferred because cost is found to exceed engineers' estimates. But this builds a reserve demand that will come in to support the market in the future. In high steel buildings, in large cities, for example, there is a distinct limit to prices that may be paid for materials without bringing the cost to a point beyond earning ability. The merchant marine cannot be built up as rapidly from American shipyards on $28 steel as on $16 steel. But these are but eddies in the main current.

The real factor in lowering prices will be increased production, not diminished demand. How fast can the output of the furnaces be increased? I say not over 15 to 18 per cent per annum. There was incredulity in as high quarters as Mr. Swank, secretary of the American Iron & Steel Association, when this prediction was made early in the year. For were there not a couple of hundred idle blast furnaces in the country ready to blow in the moment profitable prices were reached? Would American capital or energy hesitate where the reward was so great?

The easy theory, therefore, that production can be turned on, as from a faucet, when profits are high, does not fit the facts. It is needless to say that every nerve will be strained to get into operation at the earliest moment the few existing idle plants, but those who base their calculations on an increase of not over 12 to 15 per cent per annum in the next two or three years will not go far astray.

It has not escaped notice that in all the present excitement little is heard of organizing companies to build new plants. Each of the great consolidations is planning additions to capacity, but there are few schemes to develop idle property, as was the case about 1890. There are reasons for this. The building of furnaces to sell town lots was generally disastrous. The impression is still abroad that there is a large reserve idle capacity. But the main factor in restraint is that under present conditions it would require at least a year and a half to build a good modern plant; the cost would be 50 per cent greater than a year ago—and who knows where iron would be when the furnace was ready to start? The wisdom of the policy of building and enlarging in the bad times, followed for many years by Krupp and Carnegie is demonstrated in a period like this.

What of the export trade? It is generally believed that this new factor is the all-important one in sustaining American markets. Taking the iron and steel manufacture as a whole, I believe this to be true. But so far as ores, pig iron, and even steel billets are concerned, the movement has never reached 5 per cent of the product of the United States, and probably will not for years to come. Radical changes in the freight and labor situations must occur before America can capture English and European markets with crude iron. She is shipping liberally, it is true, and will continue to ship, for prices in Europe will always be regulated pretty closely by those in the United States.

But it is in the finished forms where American victories will be won, as they are now being won, in locomotives, wood and iron working machinery, agricultural machinery, nails, wire, bicycles and a hundred other lines. American inventive genius, great productive capacity, modernized plants, superior business organization, etc., will maintain

and doubtless increase the great total of $80,000,000 reached last year in her iron and steel exports. The effect of this great and growing foreign demand is sensibly felt in every department of the trade.

The belief is widespread that exports from the United States must suffer a sharp check, if not come to a full stop, unless prices in America recede. This is a natural, but not well grounded, view. It assumes that the markets of the rest of the world go their way irrespective of what the United States does. That was formerly the case, but it is so no longer. The world is now knit closely together in its industrial and commercial as well as its financial fabric. Influences that affect one nation are soon felt by the others. England and Germany were in the midst of industrial prosperity two years before it was felt in America, but now that she has responded the added stimulus is felt over there. We think it phenomenal that the mills and furnaces throughout the United States should have their product booked half through next year, but in Germany and Belgium they are already booked all through the year 1900. The great Krupp works at Essen, employing 30,000 men, are filled with orders until 1901. Germany has nearly overtaken Great Britain in pig iron product, but is nevertheless importing largely from both England and America to supply her deficiency. Great Britain shows a slackening in her shipbuilding industry, but her export trade in iron is again growing and all her lesser industries are exceedingly active. Prices of iron and steel have risen there almost as rapidly as in the United States. Middlesboro pig, that sold last year for 43 shillings, has reached 75 shillings and is now a little under 70.

The fact is, the great industrial awakening is worldwide. China, India, South Africa, the Philippines, Japan, Russia, and the new island possessions nearer to the United States are full of projects for improvement. They have caught the renaissance spirit. The beginnings are small, but they suggest immense future possibilities. They want steam railways, electric lines, electric lighting, water works, locomotives, machinery, bridges, etc., and it scarcely seems probable that, having felt some of the benefits of modern progress, they will decide to turn back. America has shown her ability to compete with the other industrial nations for this trade, and will continue to get it in increasing quantity.

A word as to the new level of prices. It is too high, of course, to be permanently maintained. It is too high for the lasting good of this great industry. But we must not be misled by making false comparisons. The conditions reached in the lean years following the panic were abnormal, not natural. Iron was forced to $6 a ton at Birmingham on wages of 90 cents a day for 12 hours' work; on transportation rates that did not return the railroads' cost; and on destruction of royalties, or values of the ore and coal in the ground. The same was practically true in the Lake Superior district. It was simply a struggle for life. Values of great properties shrunk from millions to hundreds of thousands. Labor and capital fled to other fields. America learned great and valuable lessons during this trying experience, among others, how to produce iron more cheaply than has ever been done in the history of the world. Perhaps in the end the experience may prove to have been a blessing. But we must not make the error of supposing that those were normal conditions, and that when we have escaped from them we are on an artificial basis. A sound view is that we are nearer normal conditions to-day than we were when 100,000 tons of $6 pig iron went begging for a buyer in New York. A cent a pound for the best pig iron in the world should not, after all, paralyze the faculties of reasonable persons.

It should not be forgotten that the cost of iron resolves itself substantially into three things: labor, transportation and royalties, or the value of the material in the ground. Labor, the largest item, is up 25 to 40 per cent in iron making. It is not yet too high for the good of the country. Transportation is up about as much, but who shall say the stockholders of the railroads and steamship lines are not entitled to a few dividends after years of waiting? It is now possible to credit ore and coal mines with something for the materials in the ground. But is it a violent assumption that the great iron and coal deposits of the United States, which are usually counted the foundation of wealth in an industrial nation, are actually worth something and should return a profit to their owners on material mined out? If these points are conceded, the legitimate cost of

pig iron in the United States is at least 33 per cent above the low level to which it was forced in the years from 1895 to 1898. The manufacturer's profit, if any, must be added to this. It is some satisfaction to know also that cost is rising proportionately in other parts of the world. In Great Britain and Germany the increase varies from $2 to $4 per ton, according to kind of metal and locality where it is made. This is due mainly to the steady rise in the price of coke, although ores have advanced and are in short supply.

Cautious investors as well as manufacturers quite naturally look forward to the time when collapse will again take the place of boom, and prices will drop below cost of production. Who shall stand against that day? The strong, who expect to survive, are taking extraordinary measures to equip themselves for whatever may happen. The huge consolidations—at least those newly organized—are free from bonded debts, with large provisions for working capital. Some of them, indeed, are lenders of money in the street. Nearly all have strengthened themselves by the ownership of ore mines, coal mines, coke ovens and over transportation lines, so that they are independent "from the ground up." If the time ever again comes for a fight for existence, it will be between giants, indeed, and no other nation can resist American inroads. But every observing man has noted, in the instructive years of the past decade, the wonderful tenacity of life of small plants well located and economically managed. Another thing that has not escaped notice is that in the "survival" struggle there is a marked tendency to equalize conditions in all the different districts. It is a fact capable of demonstration that the best returns on capital during lean years were not from the great concerns (barring one or two exceptions), but from certain smaller operations located in districts not usually spoken of as the cheap centers of production. It is a safe assumption, therefore, that, whatever lengths the consolidation movement may extend to, there will be plenty of strong undertakings on the outside that will keep the industry on the sound footing of free competition.

Personal.

The Pittsburg Stove & Range Company has elected the following directors: Frank Anshutz, J. S. Graham, John Rowe, J. F. McKee, George Bissell, W. T. Bradberry and O. H. Bradley.

Geo. H. Lowe, formerly superintendent for the Southern Car & Foundry Co. at Anniston, Ala., has been appointed to a similar position at the Valley plant of the Republic Iron & Steel Co. at Youngstown, Ohio.

Mr. E. H. Putnam, until recently associate editor of this paper, has accepted the position of superintendent with the Moline (Ill.) Plow Co. He will be assisted by Wm. McClelland, and J. H. Hess, formerly of Albion, Mich.

Chas. A. Watters, formerly superintendent of the Bangor Foundry & Machine Co., before its consolidation with the Hinckley & Egery Iron Works plant, into the present Union Iron Works, of Bangor, Maine, has returned to take the position of superintendent of the Union Iron Works.

The directors of the Bath Iron Works, Bath, Me., have elected Edward W. Hyde, president of the company, Gen. Hyde retiring from that position on account of ill health. The Bath Iron Works has within a decade come to the front as ship-builders, at the present time having in process of construction the following vessels: U. S. Monitor, No. 8, Connecticut; torpedo boats Dahlgren, Craven, Bagley, Barney and Biddle; steam yacht Virginia for Isaac Stern, of New York, and ocean tugs Nos. 9 and 10 for the N. Y., N. H. and H. Railroad.

Fires.

Richardson & Sons' foundry at Algona, Iowa, was burned to the ground recently.

A fire in the foundry of the Milwaukee (Wis.) Harvester Co. did a damage of $5,000.

The brass foundry operated by Burwell Carter, at Plainville, Ct., was burned Sept. 21.

The Highland Foundry Co., of Boston, Mass., suffered considerable loss in a recent fire.

The foundry of Brennan & Co., known as the Southwestern Agricultural Works, at Louisville, Ky., was badly damaged by fire Sept. 21.

Chadester & McQueen had their foundry at Braidwood, Ill., totally destroyed by fire Sept. 27.

The foundry of Joseph Hill & Son, at Warren, Pa., was partially burned Sept. 22. Loss estimated at $1,500.

The Eagle foundry at Columbus, Ohio, owned by Francis Engler, was damaged to the extent of a thousand dollars by a recent blaze.

The National Foundry & Machine Co., of Louisville, Ky., had their plant burned, entailing a loss of $30,000. The fire is supposed to have started from a live electric wire.

The large plant of Bridgeford & Co., at Louisville, Ky., was totally destroyed by fire recently. Besides the plant a great loss was also sustained in the burning of many valuable patterns. Bridgeford & Co. were incorporated several years ago, with P. Galt Miller president, C. H. Shield, vice-president, W. J. Gardiner, secretary, A. W. Allen, treasurer, and George Ogle, manager. P. G. Fischer was the foreman at the foundry. The plant was a new one, having been erected only about three years ago, when the company was reorganized, and the old plant at Seventh and the river sold to the Illinois Central Railroad.

Among the Foundries.

Convey & Racker are building a foundry at Vincennes, Ind.

The Fanner Co. will erect a new foundry at South Brooklyn, Ohio.

McMillan & Crowhurst have started a foundry at Greenwood, B. C.

Boden & Clutter will establish a foundry and machine shop at Bonham, Texas.

The North & Judd Mnfg. Co., of New Britain, Conn., will build a new foundry.

H. M. Sovereign has decided to remove his foundry from Pottsville to Lebanon, N. J.

The Pottstown (Pa.) Bridge Co. will shortly start their foundry with an increased force of hands.

The Cohoes (N. Y.) Foundry & Machine Co. have increased the capacity of their foundry.

The Illinois Iron & Bolt Company, of Carpentersville, Ill., is building an addition to its foundry.

The Marlboro (Mass.) Foundry Co. has purchased the foundry formerly operated by Malcolm McLean.

The Vulcan Foundry & Machine Co. has been incorporated at New Castle, Pa., with a capital of $75,000.

The Draper Machine Co., of Hopedale, Mass., are erecting one of the largest foundries in New England.

The Olive Foundry & Machine Co. has been incorporated at Ironton, Ohio, with a capital of $30,000.

The Gisholt Machine Co., of Madison, Wis., will erect a foundry 100x160 feet, of brick construction, with steel roof.

The H. B. Smith Co., of Smithville, N. J., is erecting a large foundry in order to meet the demands made upon it.

It is reported that the Best Manufacturing Co., of Pittsburg, will erect a large foundry in addition to its present plant.

An effort is being made to put the plant of the Aetna Manufacturing Co., at Bellaire, Ohio, into active operation again.

The American Radiator Co., with headquarters at Chicago, is reported as intending to locate a plant at Birmingham, Ala.

The Coe Brass Manufacturing Co., of Torrington, Conn., has let a contract for the erection of an addition to its plant.

The McHugh Foundry Company has been incorporated at Chicago by Newton Eastman, Harry A. Daugherty and J. E. Michelson.

The Murray Manufacturing Company, of Wausau, Wis., will erect a new foundry, 80x100 feet, which will turn out fifteen tons of castings daily.

Clifford Judson and Joseph Perry have started up a brass foundry, in connection with the Challenge Manufacturing Company, of Norwalk, Conn.

McKinnon & McFarlane, proprietors of the Caledonian Iron Works, are building a machine shop, foundry and boiler shop at Lake Charles, La.

The Gilbert Hunt Manufacturing Company, of Walla Walla, Wash., is to build a foundry to manufacture its own castings for threshing machines.

The Southern Malleable Iron Co., of Chattanooga, Tenn., will erect two additional furnaces, at a cost of $5,000, to increase the capacity of its plant.

Beal & Daniels, of Northville, Mich., advise us that besides erecting a bell foundry

they are also engaged in building a foundry for gray iron work.

Two large foundries are going up at Bessemer, Ala., to be occupied by the Bessemer Foundry & Machine Co., and the N. O. Nelson Manufacturing Co.

The Central Foundry Co. will make extensive additions to its plant at Hammond, Ind., installing much of the machinery acquired at other points.

The Illinois Malleable Iron Co. of Chicago are erecting a new malleable foundry 80x320 feet. The same will be equipped with air furnaces of the latest type.

Messrs. Snyder & Zimmerman are erecting a foundry and machine shop at Millersburg, Pa. Stave machinery will be one of the principal articles manufactured.

The Penn Foundry & Manufacturing Co. has been organized, with a capital of $100,000, at Akron, Ohio, where it has purchased the plant of the Buell Manufacturing Co.

It is said the Wilson Foundry & Machine Works, of Athens, Ga., will resume operations at an early day. This concern has been shut down for more than two years.

The Fort Worth (Texas) Iron Works has been incorporated to conduct a general foundry business, by E. B. Harrold, W. B. Harrison, George Strong and others; capital stock, $50,000.

The C. H. Dutton Co., of Kalamazoo, are developing a large export trade, having recently shipped quite a number of their engines and boilers to Havana, Manila, and Australia.

The Chicago Motor & Dynamo Co. has been incorporated at Chicago, by Walter Simpson, E. J. Saltzmann and Edward Menkin. They will operate a brass foundry in connection with their works.

A large brass foundry is to be built in the near future by the Milwaukee (Wis.) Brass Manufacturing Company, now located at 190 East Water street. The firm will increase its force from 70 to over 100.

The Maryland Car Wheel Works has been incorporated at Baltimore, with a capital stock of $500,000, by N. T. Bouton, A. G. Wellington, of Chicago, E. J. Tilkman, J. W. Stuart and H. R. Preston, of Baltimore.

The Cherokee Foundry & Machine Works Co., of Gaffney, S. C., has completed its organization, with T. H. Littlejohn, president; L. Y. Randall, vice-president; L. D. Snead, secretary-treasurer, and L. Y. Randall, general manager.

The old Whittemore foundry of West Bay City, Mich., has been bought by the Excelsior Foundry Co., who will have it torn down and replaced by a substantial structure of 50x100 feet, for a machine shop and foundry.

The Excelsior Foundry Co., of West Bay City, Mich., whose plant was burned July 8th, have moved into their new foundry plant and advise us that they have enough orders booked to run the plant to its full capacity well into next year.

The Pennsylvania Company, operating the lines west of Pittsburg, will erect a thoroughly equipped foundry in the yards at Allegheny for manufacture of all brass appliances used in car construction. Heretofore the railroad company has manufactured the brasses used on the lines west of Pittsburg at the shops in Fort Wayne.

The Sun Metal Company, of Taunton, Mass., have started a foundry for the purpose of making castings of non-corrosive white metal, aluminum, bronze, roman gold, silver and composition metals. They also intend in the near future to manufacture a line of non-corrosive white metal faucets, horse-bits, harness trimmings, etc.

The Hartford Foundry Co. is a new concern at Hartford, Conn., formed by John W. Conway, who for several years has been foreman of the Pratt & Cady Co.'s foundry, and Ernest H. Cady, son of ex-Lieut.-Gov. Cady. They have purchased the property formerly occupied by the Washburn Car Wheel Works, and will engage in general foundry work.

The Dimmick Pipe Co. has been organized at Birmingham, Ala., and chosen D. R. P. Dimmick, of Anniston, president; James Bowron, of Birmingham, vice-president; Miss Charlotte B. Blair, of Anniston, secretary. The company will locate either at Birmingham, Anniston, or Bessemer. Specifications for plant are being prepared and bids will be asked soon for buildings and special machinery; completed plant will employ 250 to 300 men.

The new foundry at Medina, N. Y., owned by W. B. Robins and Edward Sturgis, is

fast approaching completion. The proprietors intend to start work by the first of October, and will manufacture hardware specialties of every description, not being linked with the Central Foundry Company, which controls the iron pipe output, and has the management of all the other foundries of this place. It is stated that the old Brennan foundry will also be put in shape for operation at an early day.

The Duquesne Mnfg. Co. has bought the plant formerly operated by the Kensington Foundry Company, at New Kensington, Pa., which had a capacity of six tons of castings per day. This will be enlarged to ten tons per day, and the manufacture of gas stoves and ranges will be begun, and the product will include coal stoves also. The castings will be turned out at this plant, while the mounting and machine work will be done at the present establishment of the Duquesne Manufacturing Company, in Pittsburg.

Advance in Pig Iron.

Birmingham, Ala., Sept. 21.—Pig iron has advanced $1 a ton. No. 1 foundry now selling for $19.50, the highest price in twenty years. This is the second advance of $1 in ten days. A prominent iron authority said yesterday that there is not exceeding twenty-four hours' supply of iron in the district, as compared with a month's supply on Sept. 1.

Malleable Castings.

By "MELTER."

Forty years ago the term malleable iron was used with reference to an altogether different material from that of to-day. Then it was all sorts and conditions of wrought iron; now it applies to the casting industry almost entirely. Wrought iron is malleable in the strictest sense of the word, though castings are more so, for in reality the scope of a casting is not as limited as that of a bar of iron, hence its ready adaption to large territory not open to ordinary wrought iron, and thus the term has passed.

When we look back at the early methods employed in malleable casting, and make a comparison with modern practice, we must place the credit to the melters and metallurgists, who have solved the theoretical reactions and applied such knowledge to melting. The air furnace has undergone practically no change whatever, but the methods used for selecting the proper irons are radically different. Wrought, or malleable iron as it was called then, to be of good quality was silvery white and fibrous, and the malleable of to-day was thus an experiment, and every heat was liable to develop something the preceding heat did not. To-day a malleable casting of good quality will show a velvety black fracture, with silvery "glints" here and there. How many men have endeavored to produce castings with some sort of fibre? And how many have tried to cast wrought iron into green sand, hoping to thereby avoid the tedious annealing operation? It was quite alluring, and many wise heads were turned by the experiment; and still, some believe it possible. Whether it will be accomplished or not depends upon the younger element, as the older men have already had their fling at it. There has been a considerable amount in print of late concerning the theory and practice in vogue at malleable plants, and from a very close observance of the same one can make the assertion that each individual plant is operated upon its own independent method. That is, of course, if we believe all that we read. With some men there is nothing comparable with carbon for good results, others place all confidence in silicon, and following these are the devotees of phosphorus and manganese. Sulphur seems to be left out in the cold, but hold, in semi-steel it has its innings. We never used to hear all this wrangle about the composition of the metal; if it was good, and showed a clear, black fracture, the specifications seemed fulfilled. But to-day we have a critical market to face, both buying and selling, and a well-posted commercial public to satisfy. We buy everything on analysis, but do not sell so, and trust malleable cast iron will never become as scientific a quantity as that. There is no gainsaying the fact, however, that the melting operation has been given a very close attention during the last ten years, and both the old style grading and the new style of chemical calculations are given all the importance possible with direct practice. Quoting a very recent print in THE FOUNDRY, these sentiments are expressed, referring to cupola practice, but directly applicable to malleable as well, viz: "Much of the so-called new light on cupola practice that has been published has been theoretical, and untold troubles have arisen

by managements trying to imitate what nobody had actually accomplished!" There is great truth in this, and to be conservative one must be competent to discriminate against untried suggestions. Let the others experiment! But just to keep in touch, the writer offers these expressions, asking consideration of those who know as to whether his surmises concerning theory and practice are in keeping with other opinions, upon the effects of the metalloids found in pig iron.

Years ago carbon was the one great factor; there was nothing to be compared with it, and iron was selected with especial reference to the amount present, or rather, the appearance of amounts present, for we were without chemical analysis then, and we charged the darker irons with the grading of a No. 1 and No. 2! Silicon, which to-day is easily recognized, was then subordinate. Looking backward, with the aid of latter-day research by chemistry, we can readily understand the long hours required to melt small and large heats. There was with this high carbon a high silicon content, and it was an impossibility to effect the chemical re-actions any faster. But, is the metal of to-day superior to that of the earlier melts? Long time in furnace, a soft blast, and at the end a natural and easy combination of the elements produced some mighty fine iron. When comparison is made by the production of a 10-ton heat in four hours, having its metalloids carefully adjusted, and rushed along at high pressure, the original practice is out of it. But again, has the metal benefited in proportion? There is one thing, however, of which we are learning more every day, and which was not spoken of then, namely the recognition of heat conditions all through production. It stands for all that is practical and theoretical. The formations of structure in pig iron and castings, the certain percentages of metalloids in the pig, the time consumed in refining iron in reverberatory furnaces, are all contingent and consequent upon the variations of temperature! When arranging a heat to-day, the melter has an advantage not previously enjoyed, of knowing why a heat if iron will be hotter, and retain its heat longer, than a companion heat composed of No. 3 iron and sprues. In the No. 1 irons are large proportions of silicon, that metalloid, which stands for heat conditions, and in the No. 3 irons, silicon is at a minimum, hence the dullness of irons with that grading. Blast furnace people explain these differences by saying that a No. 1 iron is produced only when the stack is working very hot, and No. 3 when the furnace is chilling. Hence the presence or absence of silicon is purely a heat condition! When this knowledge is applied to malleable refining, it is naturally a great advantage.

The aim in malleable is to produce a metal which will "set" quickly in the molds, and return its carbon in combination. Often when metal is too hot, the carbon will return to the graphitic condition, because there is enough heat in metal, to allow it the chance to disseminate. This is one of the first stumbling blocks met with in melting, and the cause is often laid to carbon, while in reality there has been too much silicon present. The percentage of total carbon does not change greatly with the grading, but silicon is never constant, varying in every change of grade, in fact making such gradations possible and necessary. If the early melters recognized heat conditions, they never applied the same to their operations. Theory and reality have rescued modern melters in this instance. When a heat is charged of No. 1 iron the metal will be liquid and hot enough to tap in a few hours, but we must await until a physical re-action has taken place in the metal, namely, the combining of the carbon, and this will not occur, until the silicon has been reduced enough, to withdraw sufficient heat from the metal to insure stability of combined carbon in the castings. This is not only theory, but actual consequence.

There are two metalloids which will aid in combining carbon, manganese and sulphur, the action of the first is beneficial to the metal, though uncertain, while the latter's effect is certain and highly disastrous.

Singularly enough sulphur is another product of a heat condition. When blast furnace is working very hot it is at a minimum, but with a reversal of conditions it is maximum, for in the latter case the iron, like a sponge, is ready to absorb, and sulphur is thereby taken up from the fuel. Thus in "high" coke irons, with a large percentage of combined carbon we have also considerable sulphur to contend against. Phosphorous has already been of great aid to the foundryman in iron casting. In gray iron it is counted a great factor for fluidity, and the

same holds true in a measure, regarding malleable, though not with such directness, on account of its actions being restricted, regarding scope. If, as in gray iron, there are large percentages of carbon and silicon present, it will unite its action with theirs, but if the heat should be made up of No. 5 irons there would be no opportunity for its action on account of the dulness of these high irons.

Phosphorous, like other metalloids, has its harmful effects. Even in small quantities it has an influence upon the malleability and strength of iron at ordinary temperatures and causes "cold shortness" that is a tendency to break "short" off when cold. Manganese has of late attracted something more than a passing attention for the metallurgists are taking advantage of the knowledge that its condition in iron as a sesquioxide, has a bearing upon the certain combination of carbon, and also when in large percentages its ability to act as a flux. There has been only one objection to it and that is, when used in proportions which might suggest an excess, the annealing requires more time as the carbon has been combined higher than is usual. The effect upon the physical status is beneficial, for the tensile strength of metal high is manganese is above the average. Castings which will be satisfactory to consumers must, above all things, be of an uniform quality, and to insure this feature too much attention cannot be given the details of melting and annealing. There are many times in the hurry of business when the melter has to be absent, and at such moments accidents sometimes occur, we would rather not mention.

Information and literature on this subject should be accessible to all who may comprehend, and it is for the general welfare of the art that this is urged. The annealing operation, so the metallurgists tell us, is a process of cementation, actuated by the liberation of carbonic oxide gas in furnaces, furthered by preparing the packing in sal-ammoniac, or by using ore high in oxygen. That the carbon in castings is eliminated when high temperatures have been reached in furnace by the combination of this gas with the carbon of the castings.

Of course, primarily speaking, there is nothing which will anneal iron but heat. There are many works who do not prepare the packing in any manner whatever yet the annealing goes on, and carbon is eliminated. This may appear as negative, but it is true. To the average reader may occur the thought that malleable men are working behind a mass of theoretical deductions, having no bearing on what is a very simple process, but those who are familiar with the operation and the difficulties there encountered are very ready to adopt any theoretical reasoning, which may be helpful to them.

To those who know malleable iron, it is not a simple process. And those who do not thoroughly understand the principles there involved, have some disagreeable experiences with it. It is in the light of further knowledge that we all hope more will be written of this metal. But, as before quoted, those who have suggestions, which have never seen actual practice, had better keep same to their own selves.

The Testing of Machinery Castings.

Professor Martens has taken up the discussion of the testing of cast iron as seen from the standpoint of the builder of machinery. He brings up the point that the buyer of the casting, in order to assure himself that he is getting the proper kind of material, will require a different test from that of the founder, who wants to know what his castings can stand in service.

In the daily run of foundry work, although the foundryman could readily learn much from the composition of his charges and adjust these chemically to meet his requirements, yet he will prefer a physical test. This is true for the simple reason that, given two irons of the same chemical composition, one may be good and the other very bad, the question of process in making the pig and then the casting being all-important.

For the daily tests of the foundryman, Professor Martens outlines what he considers a convenient way of arriving at the information wanted. In casting test pieces their shape is to be of such a kind that every facility may be given the iron to draw and chill. Then, again, special test bars are to be cast for measuring contraction and for the testing machine. Thus, Professor Ledebur is quoted as recommending the following special tests:—(a) A fluidity strip 10 inches long, 1 inch wide, and 1-16 inch thick. This is gated at one end and the fluidity of the metal judged by the distance it runs in the mold. (b) A wedge, 1½ inches thick at the base and 8½ inches high. This, when

broken to show the triangular cross section, will indicate the fracture of different thicknesses and the chilling tendency of the harder irons. (c) A chill test similar to the kind in daily use in roll works. (d) A ribbed angle plate, which shows up shrinkage readily. (e) A stove plate, 2 feet square and not over 2/5-inch thick, to show the tendency to warp and draw. (f) The contraction of the iron when cast to be measured on the bar which is to be tested. This is therefore prepared with special care. (g) Practical tests by casting cylinders and pulleys, which are machined or tested in any way calculated to show the availability of the metal for the purpose intended.

In German foundries, as a rule, the bending test is the only one carried out, compression tests being a rarity, and the tensile test is but infrequently resorted to. Professor Martens also points to the value of impact tests as one that may prove the most reliable of them all. Coming to the question of tests to represent castings for commercial purposes, Professor Martens admits the difficulty of arriving at uniform specifications. Where the casting itself can be tested, such as a pipe, column, etc., the solution is not so difficult, for, as in testing boilers, one simply applies a load a given percentage higher than service conditions, and notes results. Where, however, this cannot be done, it is customary to cast a test piece out of the same ladle of iron, or cast the test piece right on the casting itself. In neither case do we get identical conditions, the temper of the sand, the heating of the mold, the variable cooling and setting effects, contributing to this circumstance. Many irons are exceedingly sensitive to such changes, and this is a powerful argument in favor of uniform methods of testing the iron in foundries. Cutting a piece out of the casting itself gives valuable information, but is attended with risks, and considerable experience is necessary to form safe conclusions.

As to the tensile test for cast iron, Professor Martens gives a very fair discussion from his own standpoint. Everyone who has made this test feels that he would hesitate to make his affidavit to its absolute correctness. With all the elaborate methods of gripping the specimen now extant, a perfect one has still to be devised, and, consequently, the results obtained are always open to doubt, no matter how carefully the test was conducted.

After discussing the difficulty encountered in satisfying both founder and buyer of castings, Professor Martens suggests the making of comparative tests based upon the bending quality and the resilience of cast iron as alone necessary to give decisive results.

Iron Mixtures for Chilled Castings.

It is impossible to state the exact percentage of the different irons that must enter the mixture for any particular kind of chilled castings. All plow makers vary their mixtures from time to time. This is necessary in order to produce uniform results. The percentage of the metalloids vary more or less in both the pig iron and the scrap, and the grade of mixture must therefore be governed by close observation of results from day to day.

One important thing to be borne in mind is that you cannot make good chilled plow castings without charcoal iron, but you must use a certain percent of it in order to produce strong casting, with a good chill. Coke iron is not a chilling iron, and the only way you can make a chilled casting from it alone is to use iron in which the carbon is already combined to a great extent. A mottled gray forge iron mixed in certain proportions with No. 3 foundry would make a chilled share, but the share would be so brittle that it would be apt to get broken before it should reach the final purchaser.

Another difficulty with this iron is that you never know whether your shares are going to be chilled on the edge, and have a gray body, or whether they will turn out white all through, and consequently, weak and worthless. You must depend for chilling quality upon charcoal iron. And remember, too, that there are two kinds of charcoal iron, viz., chilling and non-chilling. Always order specifically, chilling iron for plow castings. (The non-chilling charcoal iron is used in making malleable, and in semi-steel.)

To make first-class plow shares, the chilling tendency should be very pronounced. Such iron, cast without a chill will be gray all through, and very strong, but wherever the chill comes in contact it will quickly solidify and remain hard and white, but it will be gray and strong everywhere else; therefore it produces a very strong, well-chilled, good-wearing share.

It is not necessary, however, to use all charcoal iron to produce these results.

You may find the following a good mixture to start with, varying it according to need:

Sixty percent chilling charcoal iron No. 5, 40 percent coke (foundry) iron No. 3. The smelt (that is the sprues and other scrap from this mixture will, in use greatly modify the rule.)

Bearing in mind all the above, any ordinary good foundryman ought to be able to make good plow shares. I assume, of course, that the foundryman knows that the fuel must be approximately free from sulphur. Iron takes up the sulphur from the coke very rapidly, and the casting produced will be apt, where sulphur is in excess to have a honey-comb appearance, resulting from occluded gas, and it will be very weak. Furthermore, where sulphur is in excess, it is impossible to control the mixture—it will sometimes be too hard and sometimes too soft. In the south, the Flat Top Pocahontas foundry coke is mostly used. The ordinary southern made coke such as is used in blast furnaces is unfit for the cupola. There is, however, a coke made at Chickamauga which cannot be excelled for foundry use. At least this is true of the sample I used some years ago when I was conducting a foundry in Tennessee. I understand that the coke is now being made in large quantities. I believe the name of the firm is the Chickamauga Coke Co., but wherever you get the coke be sure that it is "72-hour foundry coke."—E. H. Putnam in The Tradesman.

Small Cores.

Of all the sources of trouble in a foundry engaged on small castings, none are so fruitful of evil as the cores. Many a waste can be traced to the core bench, and a little attention given to that bench would without doubt increase the quality and turnout of castings in many of our foundries.

The faults in cores are many. Some of the most annoying are cores intended to be round having flat spots, or even being oval. Then, again, the cores are too hard or, on the other hand, too soft and crumbly, with the further irritating trouble of choked vents. Any one of these faults should condemn a core, for they are simply the result of carelessness. The oval cores can be accounted for by the two halves of the corebox not being tightly closed, and the molder who puts such a core into his mold is as much to blame as the core boy who made it. The hard cores may be owing to the sand used being too wet and rammed too hard, or possibly, in mixing the sand too much binding material may have been added. Metal, especially when dull, will not lie at all kindly on a hard core, and when such is used the castings are more or less "blown." Crumbling cores may be due to the core sand being dry, softly rammed, or they may have been burnt in the stove. Cores that lie in the foundry and become air-dried before being put into the stove are also crumbly and bad for the molder to handle. With regard to choked vents and the various diseases small cores are subject to, nothing but a strict supervision of the core bench will remedy them. For small cored repeat work the cores used must be above suspicion; they should be the exact shape of the box, with a clear vent, and made from a sand or mixture of sands that will not absorb moisture when placed in the mold.

The locality of a foundry in nearly all cases determines the kind of sand available for core making. Erith, Belfast and Mansfield are the three most popular sands for small work. The coarser the sand in texture, the better chance there is of getting a clear vent, but the liability to scab and of the metal to search or burn into the core is increased. For small and intricate cores the sand of necessity needs to be firm and coherent, in order to successfully make and handle them when green.

Many and varied are the materials employed to increase the efficiency of the sand. A few of these are rosin, flour, pease meal, salt, sugar, molasses water, sal ammoniac and the prepared "core compounds." The object of any such addition is to facilitate handling the core when green, and to give a firm, hard skin when dry. Although hard, the structure of the core should be open, in order that it will vent freely.

Rosin mixed with red sand will give a firm core, which meets with much favor in many brass foundries. A coarse and open sand can be used if mixed with flour or pease meal. On casting, the flour burns out, and the core can readily be knocked out of the casting. Salt, sugar or molasses water have

pretty nearly the same effect—they harden the skin, but do not obstruct the vent. It is claimed for sal ammoniac that, if dissolved in water and mixed with the ore sand, it will prevent the metal searching or burning into the core. For steel, gun metal, phosphor bronze, or, in fact, any alloy prone to search into the interstices of a core, this is a valuable property and one that will save the dressers much work. Coal dust or plumbago mixed with the sand have a similar effect. Core compounds possess many advantages; they are mixed with the sand, and give firm cores that will stand severe handling by the molder when fitting in. They are also used, mixed with water, for swabbing the broken edges of a core. Many foundries mix core compounds with the blackwash for painting cores and molds.

For intricate cores of small sizes it is at times somewhat difficult to decide on the best method of venting. In many cases it is impossible to pierce with a vent wire or to draw a vent string. A common device is to put in a fibre of hay, which chars out as the core dries; or strands of thread well soaked in naphtha will, in cores of small diameter, prove effective. The so-called "flexible vents" are very useful. They are essentially a thread coated with tallow or similar substance, which melts out as the core dries, leaving a clear hole. The objection raised against these vents by some molders is that as the tallow melts out it leaves a thin coating round the hole. This coating, being impervious, obstructs instead of facilitating the vent. Wax tapers can be used with advantage in a similar manner.

In cores of larger sizes, but of irregular shapes, ash vents are without doubt the most satisfactory. Before pasting the two halves of the core together, channels are cut and filled with fine ashes free from dust. A string or vent wire is inserted to lead the vent through the prints. —P. Longmuir in Mechanical World.

Fluor Spar in the Furnace.

The growing demand for fluor spar in metallurgical processes has brought many inquiries regarding its value in the blast furnace. It is difficult to give a precise answer thereto, for very few records are available. In these days of forced production, however, every point counts, and if the use of fluor spar in the blast furnace results in either a decrease in the fixed charges for making pig iron or in giving a greater fluidity to the slag, with incidental chemical benefits, at a cost no higher than the present, the time and trouble taken to establish this will not have been wasted.

The published records seem to indicate that fluor spar was a regular admixture with European blast furnaces in former days, the comparatively cheaper limestone eventually superseding it in everything but the production of ferro-manganese and ferrosilicon, where the chemical reactions it gives rise to make it highly desirable. From this we would judge that so far as the lining of the blast furnace is concerned a moderate addition of fluor spar would not hurt it, the increased fluidity of the slag keeping the lining clean and freer from obstructions than would otherwise be the case, a fact borne out by daily cupola practice where the continued use of the proper amount of fluor spar is a real advantage in every way.

While fluor spar is about ten times as energetic in its action as limestone, one point must be borne in mind, and that is the amount of slag required to keep a furnace in good working order. Here we have the root of the matter. If it is necessary to have a given quantity of slag to run properly, then we cannot take advantage of the powerful action of the fluor spar to the extent that we would like. This seems to be the case in actual practice, and the question would arise what are the benefits a moderate use of fluor spar would bring about? First of all, an increase in the fluidity of the slag, then an enrichment of the bases in the slag to the extent of about 10 per cent, and finally a dephosphorizing and possibly also a desulphurizing action on the pig produced.

That the extra fluidity or livening up of the slag is an advantage, goes without saying; the chances for scaffolding are reduced greatly, and an even working on the part of the furnace is more likely. The amount of mill cinder usually added will be taken care of better and will not accumulate with damaging results to the pig iron, so far as its phosphorus contents is concerned. In the preparation of basic iron, so much called for nowadays, the addition of fluor spar allows a lowering of the high temperature necessary to render the slags produced fluid enough to handle properly, and this in turn

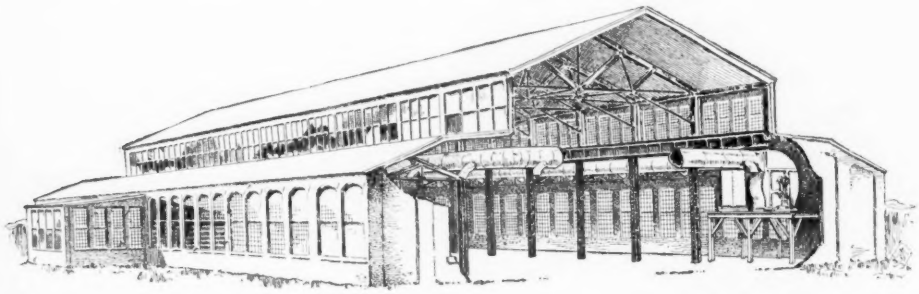
means lower silicon in the pig. This is an improvement, for with direct metal from furnace to converter there is no need of the high silicon formerly necessary to properly blow a heat of pig iron remelted in a cupola.

The recent experience of a furnace in the Shenango Valley, which got over a severe case of scaffolding by blowing several hundred pounds of fluor spar through the tuyeres, would show that it is very useful in emergencies.

The best plan to pursue in using fluor spar in the blast furnace would be to follow cupola practice to some extent, beginning with one-tenth of one per cent, and gradually increasing the amount as the results obtained may indicate.—Richard Moldenke in Iron Trade Review.

A Typical Shop Heating System.

Our illustration shows one of the buildings of the Siemens & Halske Electric Co., at



Chicago, equipped with the Sturtevant system of heating. This building is of the simplest type of modern one-story shop. Its width demands light at the center, which is provided by the monitor, the introduction of which, however, has a marked influence in determining the method of hot air distribution to be introduced.

As a rule, it is undesirable to attempt to place the piping on one side only and blow the air across such a building, because of its tendency to rise to the monitor in the center. The principle generally followed is to discharge it entirely around the building and toward the outer walls. To this end, the apparatus is placed upon a platform, for the double purpose of economizing floor space and providing for the natural return of the water of condensation to the boilers without the use of a return water apparatus.

By this arrangement the fan is enabled to discharge the air directly into a line of horizontal piping extending around the entire building at some distance from the walls. At proper intervals outlets are provided, through which the air is delivered in such a direction as to strike the floor near its intersection with the outside walls. The most vulnerable point is thus attacked, and a warm barrier of air interposed between the occupants and the cold walls.

1845-1899.

Over half a century ago the well-known foundry and hardware specialty business, conducted during the past five years as the Estate of Oscar Barnett, was established at Newark, N. J., by Mr. S. D. Barnett. At his death he was succeeded by his son Oscar Barnett, who carried on the business up to the time of his death, five years ago, since which time his three sons, Oscar, Jr., Albert D., and Frank S., have conducted the business under the above name.

The reputation gained by the house during the past fifty-four years for honorable business methods and strictly high-grade goods, has kept the sales at such a point that with the growth in business from the present prosperous condition of the country, it has become necessary to provide for a larger output.

It has therefore been decided to form a corporation, and the Oscar Barnett Foundry Company has been incorporated under the New Jersey laws. The Barnett interests continue with the new company, and the services of Mr. Gerald Hannan, for several years past, secretary of The American Axe & Tool Co., have been secured as treasurer and business manager, while the manufacturing will be in charge of Mr. Albert D. Barnett as superintendent.

The capital has been largely increased and it is the intention of the management to add to the capacity of the works and to

strictly maintain the quality of the product.

One specialty of the company is known to brass founders everywhere, the Oscar Barnett Standard Bevel Brass Molders' Flasks, which have been in use many years, and are still recognized as the standard.

The new company will continue the manufacture of these flasks, as well as their numerous hardware specialties, soft, smooth castings, and a variety of tools. They have recently become interested in a new patented arc lamp, specially adapted for floor shops, which has been already introduced to the trade and meets such favor as to warrant the expectation that it will become a great success.

The Record Broken.

It was thought that the tonnage of sales of pig iron reported by Rogers, Brown & Co. for 1898, amounting to something over 1,000,000 tons, was the greatest amount ever sold in one year to actual consumers of foundry and forge iron by one firm. Rogers, Brown & Co. have not rested on their laurels but state that during the first eight months, to Aug. 31st., of the present year, their sales of pig iron have amounted to over 1,000,000 tons, and sales during September are proceeding at about the same rate. They have ten houses located in the principal distributing centers of pig iron, the latest one established being at Birmingham, Ala.

Notwithstanding the contracts that have been placed, the information received by Rogers, Brown & Co. from their various branches and salesmen shows that a large majority of consumers have not yet covered their pig iron requirements for the first half of 1900, and it seems apparent that demand will continue good for the remainder of this year.

The Advantages of Industrial Consolidation.

The time has gone by when it is necessary to argue as to the right to exist of large aggregations of capital, for the purpose of industrial development.

In America, in addition to the advantages of putting private businesses into corporate form, the benefits of consolidated management are obtained, and the advantages of larger aggregations of capital and ability are thus secured.

If the writer were asked what these are, the answer would be difficult only because the list is so long. The following are the principal ones: Raw material bought in large quantities is secured at a lower price; the specialization of manufacture on a large scale in separate plants permits the fullest utilization of special machinery and processes, thus decreasing cost; the standard of quality is raised and fixed; the number of styles is reduced, and the best standards are adopted; those plants which are best equipped and most advantageously situated are run continuously and in preference to those less favored; in case of local strikes or fires the work goes on elsewhere, thus preventing serious loss; there is no multiplication of the means of distribution; a better force of salesmen takes the place of a large number; and the same is true of branch stores; terms and conditions of sale become more uniform, and credits through comparisons are more safely granted; the aggregate of stocks carried is greatly reduced, thus saving interest, insurance, storage and shopwear; greater skill in management accrues to the benefit of the whole instead of a part; and large advantages are realized from comparative accounting and comparative administration.

Such are some of the advantages of consolidation. The grand result is a much lower market price, which accrues to the benefit of the consumers, both at home and abroad, and brings within reach, at the cheaper price, classes and qualities of goods which would otherwise be unobtainable by them. This is the great ultimate advantage, and if this were not sooner or later true, if the world at large did not ultimately reap the benefit, the other advantages would be as nothing.—Charles R. Flint, in Cassier's Magazine for September.

The J. D. Smith Foundry Supply Co., of Cincinnati, have published a memorandum book, of vest pocket size, containing the price list of castings as recently established by the Milwaukee Foundrymen's Association. Better send and get one.

The neatest piece of printed matter we have seen in a long time comes to us from the Whiting Foundry Equipment Co. of Harvey, Ill., in the shape of their Crane and Air Hoist Catalogue, No. 19. The book contains 100 pages, and is profusely illustrated with half-tone engravings of cranes and air hoists

made by this company. It will be sent to anyone interested in modern equipment upon request.

Quite a Business.

With the declaration of the dividend of 1¾ per cent. on the preferred shares, the directors of the American Car & Foundry Company issued a statement of earnings showing $1,238,588 net profits in the five months ended July 31; during that time the company's output was:

Passenger cars manufactured.....	61
Freight cars manufactured, including refrigerator and caboose cars.....	26,269
Wheels manufactured for passenger, freight, motor, and mining cars....	315,315
Axles manufactured for passenger, freight, motor and mining cars, tons	5,600
Castings manufactured for cars, locomotives, and miscellaneous work, tons	29,106
Bar iron made, tons.....	30,186
Water pipe made, tons.....	4,154
Brass journal bearings made, lbs....	424,800

A Michigan Pun.

The Charlotte Foundry Company is the latest, and Thomas J. Green and John S. Moon are the company. Hustlers, both of them, and they will turn out products that do not conflict with the local foundries, such as lamp stoves, Mrs. Potts' sad irons, hot air registers, gas heating plates, etc., adding and enlarging as the months pass. The Moon may be made of Green cheese; but these men will build up a successful business.—Charlotte (Mich.) Tribune.

Not so Bad, for a Reporter.

A goodly amount of business prosperity has attended the Merriam & Tilden foundry on Hope street, since its inception a few years ago. At first seven men were employed. The number has been increased until at present twenty men are kept busy. Last week the largest casting ever poured hereabouts was made. It was a 16-foot lathe-bed and required nearly a ton and a quarter of molten metal in its manufacture.

To watch the making of a casting is an interesting sight. They are made in moulds or "flasks." These flasks, as they are called, are boxes of sand in which an impression of the gate or pattern, is taken. After the required number of flasks are ready, the "wind" is let on. Letting on the wind is starting up a bellows-like arrangement which forces the hot air up through the cupola which has previously been filled with bars of pig iron, under which a large bed of coal is fiercely burning.

When the metal is hot enough it runs out a spout in the front of the cupola and is caught in a caldron. The moulders' ladles are filled from this caldron. This "drawing the iron" as it is called, is a very pretty sight. Sparks fly in every direction and look very much like a large flower pot in a pyrotechnic display. This effect is more or less intense according to the hardness of the iron.

A flask which has been poured into must be finished without a stop. If the molder stops an instant in pouring in the molten metal and then resumes, a seam will form at the place of the stopping and a worthless casting will be the result.

In pouring large castings like the one mentioned above, a crane and chain blocks are employed and a continuous stream of metal is kept flowing until the flask is full.

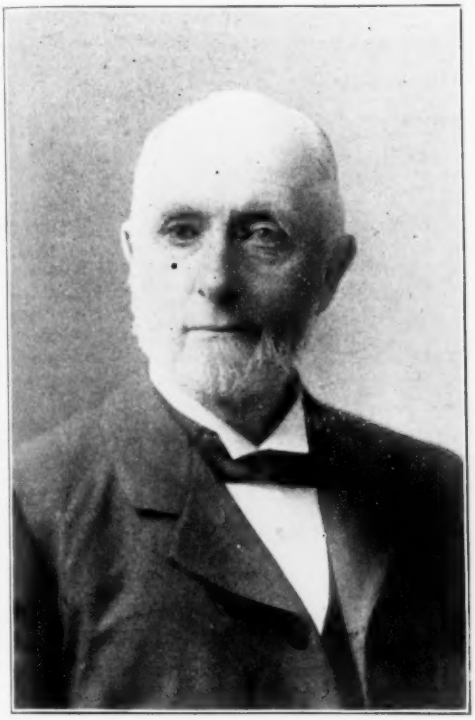
That a casting of the dimensions of the one herein described should come out perfect and straight as an arrow, reflects much credit upon Manager W. A. Kenney, and his workmen.—Greenfield (Mass.) Gazette.

A brass founder writes us that phosphor bronze can be spoiled readily enough if, in order to use too much lead, the founder puts in too much phosphorus to make it stay in the composition. The opinion is further expressed that few companies using phosphorus can tell definitely how much phosphor they get into a casting. They know how much they start with, but with phosphorus that does not count, as it is such a volatile substance. This founder's remedy is for discoloration by oxide in the use of phosphorus to use less lead and less phosphorus in making bronze mixtures.—Aluminum World.

The Monterey, Mexico, foundry now employs 235 men regularly. Most of the skilled mechanics are Americans, who receive on an average from $5 to $8 per day. The laborers are all Mexicans, who receive from 75 cents to $1 per day. About 1,000 tons of pig iron are imported from the States each year by this company.

Deaths.

John Humphrey Sessions, of Bristol, Conn., who enjoyed a world-wide reputation as a manufacturer, died in that city recently. The deceased was born in Burlington, Conn., in 1728, and first engaged in manufacturing at Polkville, Conn., later succeeding to the business now known as J. H. Sessions & Son. The outgrowth of this concern was the Sessions Foundry Company, one of the most complete institutions of its kind, of which Mr. Sessions was president. Besides being



JOHN HUMPHREY SESSIONS.

at the head of the two aforementioned firms, Mr. Sessions was also a director in the Bristol & Plainville Tramway Co., president of the Bristol National Bank, and a trustee of the Wesleyan University and the Wilbraham Academy. The deceased was the first member in his family to die within a lapse of time covering fifty-one years. He is survived by a wife, two sons, John H., Jr., and William E., also by a daughter, Mrs. Carrie Neubauer, all of whom reside in Bristol.

William McCarthy, one of the foremen in the Broadway Iron Foundry, of Cambridg, Mass., died in that city recently. He was a native of Ireland, and 54 years of age.

Thomas McKenna, founder of the firm of A. & T. McKenna, brass founders at Pittsburg, died suddenly in that city, Sept. 19, aged 63. In 1857, with his two brothers, John and Alexander, he opened a brass foundry on Third avenue. The business continued to grow until the firm now has a trade extending over a wide territory. He was the last member of the original firm, the others having died some years ago.

Edward Gough, the well-known brass and roll founder, of Allentown, Pa., died recently. The deceased was born in West Brumage, England, June 25th, 61 years ago. He learned the trade of a brass and roll founder in England and became an expert workman. He emigrated to this country 32 years ago and settled in Pennsylvania. Shortly afterwards he started a brass and roll foundry, in partnership with a Mr. Robinson, under the firm name of Gough & Robinson. The partnership continued only for about a year when Mr. Gough purchased Mr. Robinson's interest and has ever since conducted the business alone.

The melting point of aluminum is 1160° F., or 626° C., a temperature which may be regarded as a most convenient one, since it is far enough above any temperature possible in culinary processes, and yet low enough to present no difficulty to metal founders. Old or worn-out aluminum vessels can easily be melted down, and the full value of the ingot metal recovered.

There was a time the quality of pig iron made with charcoal was not believed to be any better than that made with coke. The Lake Superior charcoal furnace men could not get any higher prices than any one else a year ago. But that impression has been overcome and it is now admitted that it is no longer true, and the demand for charcoal iron, especially for making car wheels is growing keen.—Exchange.

The Northern Engineering Works, Detroit, Mich., are putting on the market a line of Air Hoists from ½ ton to 20 tons capacity.

The Cleveland Facing Mill Co., Cleveland, Ohio, well known as the manufacturers of C. F. M. Founders' Perfect Wash, have lately issued a complete catalogue of things that keep a foundry running. It will be sent to any address upon application.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED—An experienced chemist and metallurgist. Address "Chemist," Box 324, care THE FOUNDRY.

FOR SALE (on account of sickness)—Foundry machine shop and feed mill; doing a profitable cash business. MRS. M. WARD, Newcomerstown, Ohio.

FOR SALE—One 3 to 4 ton jib crane, hand power. Blue print and price on application. JAMES LEFFEL & CO., Springfield, Ohio.

FOR SALE—One No. 4 1-2 Baker Blower, now running, melting 5 tons per hour in 40 inch cupola. Have built larger cupola, requiring larger blower. JAMES LEFFEL & CO., Springfield, Ohio.

FOR SALE—Second hand. One 63-inch Boston blower, 11-inch outlet, good as new. One 5-ton foundry screw ladle, in good working order. AMERICAN HOIST & DERRICK CO., St. Paul, Minn.

WANTED—A working or boss brass molder to take charge of six to eight men. One familiar with mixing of metals, new foundry methods, etc. State age, experience and salary expected. Address "BRASS CO.," Box 318, Care THE FOUNDRY.

WANTED—A position as general manager or superintendent of malleable iron plant; 30 years' experience in all its details; can furnish plans of and superintend construction of same. Address "BASIC MALLEABLE," Box 319, Care THE FOUNDRY.

WANTED—A first-class stove pattern maker, competent to carve and design the latest style of stove ornamentation, with 25 years' experience, wants a position in a stove works. Address "PATTERN MAKER," Box 317, Care THE FOUNDRY.

WANTED—Position by a foundry foreman; experienced on Corliss engines, air compressors, light and heavy machinery castings. I understand machine molding and can give good references. Address "CASTINGS," Box 323, Care THE FOUNDRY.

WANTED—Situation as foundry foreman. Twelve years' experience in heavy and light work. Thoroughly posted in iron cupola practice and the handling of large forces of men. References supplied. Address "FOREMAN," Box 313, Care THE FOUNDRY.

WANTED—A position as foreman in malleable iron foundry I am thoroughly acquainted with the business; pattern making, mixing, melting, and annealing; also up-to-date in wrought iron casting. Address "MALLEABLE," Box 321, Care THE FOUNDRY.

WANTED—A competent foundry foreman to take complete charge of a large foundry making a specialty of Gas and Gasoline Engine castings. To the man who is able to turn out this kind of work in a first-class manner a good salary will be paid. Address, "GAS ENGINE," Box 325, care THE FOUNDRY.

FOR SALE—Foundry. Parties wishing to purchase a foundry can get a bargain. Shop situated in town of 12,000 population and running every day. Will take the amount of purchase price altogether or partly in castings. Best of reasons for selling. Address enquiries to "BARGAIN," Box 305, Care THE FOUNDRY.

FOR SALE—One Baker rotary pressure blower, No. 4½, capacity 16½ cubic feet, per revolution; second-hand, thoroughly overhauled and practically as good as new. One new Ames lively upright, 7x8; engine direct connected to above blower. Price of engine and blower, $375. Address AMES IRON WORKS, Oswego, N. Y.

Rogers, Brown & Co., the pig iron men, have opened a branch house in Birmingham, Ala., with W. L. Sims & Co. as representatives there. Their offices are in the Steiner Bank Building.

As far as the iron trades are concerned, probably no line of industry produces better advertising matter than the stove foundries. Whether this be show-cards, newspaper and magazine ads, or catalogues, these people are always to be found in the front row. We are prompted to say this from a cursory glance at the catalogue now being mailed to the trade by the Scranton Stove Works, Scranton, Pa.

The Ajax Metal Co., of Philadelphia, extend a cordial invitation to all railroad managers, motive power and mechanical officials to pay them a visit at "Section M-13, Main Building," of the National Exposition, which is now being held in that city. They will have representatives there at all times, and will take pleasure in offering their services to all visitors. Ample facilities for correspondence will be provided, and every attention shown visitors.